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THE ENGINEERING BUILDING.

Mr. Carnegie never does anything by halves! After the American Society of Civil Engineers decided not to unite with the other engineering societies in accepting his generous offer of $1,500,000 to construct an engineering building, some doubt existed as to what course Mr. Carnegie would follow. It did not take him long to decide, as the letter printed on another page of this issue will show. Mr. Carnegie has not merely renewed his first offer of $1,000,000, but offers now also the $500,000 tendered to make room for the Civil Engineers. We feel that this gift will become an important factor in our technical development. Certainly Mr. Carnegie has done his full share, for never before was such a generous gift proferred to any engineering body or group of bodies. And we also believe that this gift will be utilized to the best advantage. In fact, it will be difficult for any one to suggest a better use.

THE PASSING OF THE MAIN BELT.

The essential element in the organization of manufacturing establishments is the relation of the prime mover to the productive machinery, and as the vertical shaft with its beveled gear has long been a matter of history, the later type became that of the main belt which involves a great deal of space, interrupting the light, and entails a continual expense for maintenance and repairs after the first cost.

The manufacturing Mahomet must go to the power mountain whether it be that of the water-wheel or steam engine. The first sites for manufacturing were necessarily at the locations where the water power was developed, and later when improvements in the steam engine warranted its use, there was still required the close relations and sites essential to cheap transportation of fuel. These conditions furnished the predominant factors, not merely in location, but also in the details of mill design.

The Effect of the Introduction of Electric Power.

The introduction of electricity for the transmission of power has changed this necessity of the close physical relation between prime mover and the machine. It is enabling the development of water powers; it is providing for the delivery of power wherever it may be required, particularly in connection with artisans in cities using small amounts of power.

A Long Transmission.

The distance to which power has been transmitted has reached to 300 miles in California, where the power was delivered to the various motors in a city from the generator at a distant waterfall, when the power station at nearer proximity to the cities was destroyed by fire.

The Utility of the Waterfall.

As Emerson says, that "a weed is a plant whose use is unknown," what term can be applied to the various waterfalls whose energy for ages has merely contributed to the beauties of the scenery?

These waterfalls are being harnessed to the service of man and productive forces resulting from their energy are adding to the useful work of mankind. This distribution of power is solving questions of sociology relative to the operatives engaged in manufacturing. It is tending to place works in more advantageous localities. It is providing facilities for the smaller units of production of goods requiring higher measures of skill.

An Interesting Case.

For many years a well-known water power was seeking customers after the construction of a canal giving a minimum of 30,000 horse-power, but as engineer after engineer had investigated the conditions they ascertained that the bank between the canal and the river contained a clay substratum over rock, whose

inclination was at such a pitch that it would be unsafe to place heavy buildings upon the necessary site. Promoters, engineers and capitalists took up that problem until it was an old story, tiresome in its reiteration, until a few years ago an electric power plant was installed on the site and transmitted the energy of the falling water to mills which have been built in a neighboring city and which are providing employment for a large population.

Advantages Other than Mere Transmission of Power.

Electric transmission of power for manufacturing is not confined to conveying the energy from waterfalls at a distance, but in existing plants, and where the power is furnished by steam engines the substitution of copper conductors for the main belt is proving advantageous, not merely in the reduction of prime costs but in the greater economies of the improvements in products, resulting from more uniform motion and the better illumination which results from the abolition of shadows from main belts and their distributing belts.

LIFE AND EFFICIENCY OF THE NERNST LAMP.

The last report of the committee appointed by the National Electric Light Association to investigate the photometric properties of arc lamps gave very complete information regarding the life and efficiency and the distribution of light given by the American type of Nernst lamp.

Tests of German Lamps.

Work of a similar character, though not as completely reported, has been done abroad on the German type of lamp, with the following results: the Physikalisch-Technische Reichsanstalt, of Charlottenburg, has found that the mean life of the lamps which it tested was 286 hours. Wedding, on the other hand, found it to be 538 hours. There is no agreement here, but probably this wide difference was only to be expected, as in each case only six lamps were tested. So far as other measurements go, however, the agreement is very satisfactory, better than was to be expected from the small number of lamps. Bussmann found the mean candle-power to be 139.1 Heffner units, equivalent in English units to 122.4 candles, and an average consumption of 1.85 watts per British candle-power. The figures obtained by Wedding are 123.2 British candles and 1.785 watts per candle. Both sets of lamps were rated at one ampere and 220 volts. The figures quoted were obtained under laboratory conditions, where the voltage was exceedingly steady, and it is probable that the results obtained in actual practice would not have been quite as good. Moreover, some of the figures used in computing these results were obtained from lamps started by means of a spirit lamp. As there was no heating coil—which in the German lamp is wound spirally around the glower—there was no loss of light due to this mechanism. There is nothing to indicate that in actual service the German type of lamp would excel that made in this country. It should be mentioned that these German lamps are used only with direct currents, while the American lamp is used on alternating currents.

LINE CONSTRUCTION.

The paper by Signor Guido Semenza, on European practice in the construction of high-tension transmission lines, which was read at the recent meeting of the American Institute of Electrical Engineers, brings out the difference in the practice of European and American engineers. In this country transmission lines are almost invariably supported by wooden poles placed close together and only high enough to support the wires well out of the way of passing vehicles. The wires are supported on heavy porcelain or glass insulators, in turn held by strong wooden cross-arms, and the spans are made comparatively short, in order that the poles may safely bear the strain due to the wind and sleet and snow. In Europe they have followed a different practice. The poles are made of structural steel, with steel supports for the insulators, and are carefully designed to bear the strain of the wires and the wind, without being unnecessarily heavy. The poles are made considerably higher than the poles used in this country, and they are placed at correspondingly greater distances apart. Wherever possible, the transmission line is carried in a straight line, and preferably across country, rather than following the roads.

Reasons for Difference in Practice.

Those who took part in the discussion of Signor Semenza's paper seemed to agree that the European method is better engineering, and a number of reasons were put forward to explain why we had seemingly lagged behind in this branch of the art. It was said that European engineers pay greater attention to small matters, and that they have time to do this, as the construction work is not carried through with such haste as is customary here. Another speaker thought that the difference in practice might be attributed to the different class of men who carry out our line construction. It was his opinion that, while we paid the greatest attention to the design of machinery for stations, the question of line construction was left largely to linemen. These hardly seem to be sufficient reasons why such marked difference in practice has arisen. American engineers never hesitate to use iron in place of wood when better results are obtainable, and the labor required to design an iron pole suitable for use over the entire line would not be great. Any structural iron works would be glad to submit designs for poles, if given data for the weight, wind strains and spacing of the wires. Nor is it apparent that the engineers have neglected the line and put all their energy on the power-house. Transmission lines are generally calculated very carefully, because they are expensive; and certainly the engineer in charge of the work should have something to say about the way in which the line is to be erected. A more plausible explanation of the difference in practice is, that the wooden pole construction is giving very satisfactory results, and engineers have not seen sufficient reason for discarding the old and well-tried method for the new.

Difference in Insulator Practice.

The difference in insulator practice is more a result of experience with the various types than a question of skillful de-

sign. When very high voltages came into use in this country, insulators were designed to prevent loss through leakage over the surface. Our design developed into large insulators with a number of wide petticoats. The European engineers find that insulators with a small number of petticoats, spaced further apart, give better results, because they are more easily cleaned.

Now that the two systems of construction have been compared, we may feel sure that the European will receive careful study in this country; and if it appears better and not too expensive it will probably be adopted. We are always ready to give up our systems for something better as soon as we are convinced that it is better.

ATOMS AND MOLECULES.

It is to be regretted that engineers, and some physicists too for that matter, are too often careless in the use of the terms "atom" and "molecule." Time and again they are used indifferently to indicate similar particles of matter, although when used with the correct meanings, it is seldom that the two terms can be applied to the same particle. Should a chemist show the same laxity in expression, he would be laughed at by his whole profession.

According to the atomic theory and the ideas held until recently by physicists, molecules are the smallest particles of matter which can exist alone. Atoms are the smallest particles into which an element can be divided. That is to say, it is the smallest part of an element that can enter into combination with other elements. Atoms of different elements combine to form molecules of compounds and even the molecules of elements themselves are usually formed of groups of atoms, though there are a few cases where apparently a single atom acts as a molecule. There is thus a distinct difference in the meaning of the two terms which should never be forgotten. One may speak of the stability of an atom with propriety, but to talk about the stability of a molecule, meaning it is indecomposable, is absurd, since in every chemical reaction certain molecules are broken up and others formed. On the other hand, to the chemist at least, the atom is unchangeable and permanent.

There is all the more need at this time to be careful in the use of these terms, as there are other newer terms coming into use, these also relating to certain particular subdivisions of matter. Thus, the term "corpuscle" is used by Dr. J. J. Thomson to designate those minute particles of the molecules of a substance which are torn off when electricity is passed through the gas. The term "electron" is used in much the same sense, though it usually emphasizes the fact that these particles are charged bodies.

The Ion.

There is also another term, due to Faraday, and used by electrochemists. The ion is that particle of matter which effects electrical induction in electrolytes, and, according to the German theory, which is an atom or a group of atoms positively or negatively charged. The term is sometimes used in describing gaseous conduction with much the same meaning, and designates the charged gaseous particles which effect the passage of current

THE N-RAYS.

BY DR. J. B. WHITEHEAD.

An interesting and unusual situation has developed in the field of physical research. About a year ago, when some of the remarkable properties of radium were being given to the world by the Curies, and when those of the Rœntgen rays were still fresh in mind, Professor Blondlot, one of the foremost of French physicists, announced that he had discovered a new type of radiation. Like the Rœntgen rays and those from radium, the new radiation was able to penetrate opaque substances, but unlike them it was a periodic disturbance; that is, it had definite wave-lengths, as do light and heat radiations. It was in the latter aspect that the new radiation appeared of great importance and interest to physicists, for the waves were of lengths hitherto unknown. Professor Blondlot called the radiation the N-rays, after Nancy, the city in which he carried out his experiments.

The properties of the Rœntgen rays and those from the radioactive substances radium, thorium, etc., are so familiar and so readily demonstrated, that the announcement by so well known a physicist as Blondlot of the discovery of a new form of radiation was at first accepted without question. Nor is it evident as yet from the interesting accounts in the daily press that there is any doubt as to the existence of these so-called N-rays. Their properties have been described at length, and from the most recent accounts one wonders what new sources of the rays are next to be discovered. Blondlot found that they were emitted by a Rœntgen tube, a Welsbach light, a glowing metal, and by the sun. Later it developed that they were given off by metals under tension and bending stress, and now, according to Charpentier, human nerves, muscles and the brain during activity emit the N-rays, so that by means of a phosphorescent screen one may "see himself think." Certainly the interested reader is justified in assuming that they are as real and as evident as the Rœntgen and radium radiations.

As a matter of fact a grave doubt is entertained among many physicists as to whether the N-rays exist at all. Blondlot's announcements described experiments which indicated that the rays were of the same nature as those of light and heat and that they came within the heretofore blank region of wave-lengths lying between the longest light and shortest electric waves. This announcement alone, without the name of Blondlot, would have been sufficient to attract the attention of physicists. As it was many of the best known in the world at once attempted to repeat Blondlot's experiments, and all, certainly without important exception, met with no success. These failures were in no sense due to any inherent difficulty or delicacy of the experiments, as they were perfectly simple and straightforward. The sole evidence of the existence of the rays in any of Blondlot's experiments was the brightening under their influence of an electric spark, a flame, a piece of faintly illumined paper, or a phosphorescent screen. In other words, it all depended on Blondlot's eyes, and other investigators simply failed to observe the variations of luminosity detected by him. Among the names of those who have announced their inability to detect the N-rays are those of Kauffmann, Donath, Rubens, Drude, Classen and Wood, all experimenters of the first ability.

That the eye is a most unreliable instrument for measuring the intensity of light has long been known. To what

errors it is prone may be demonstrated by the simple experiment of looking fixedly at a dim star on a dark night; if the eye be allowed to shift ever so slightly to one side the star will appear much brighter. In fact Lummer has shown that variations in intensity of the magnitude of those observed by Blondlot can be largely accounted for on such purely physiological grounds. The remarkable aspect of the matter is that Blondlot should have so frequently observed these variations. His acknowledged ability and experience would seem to preclude the possibility of any such repeated error. The most valuable of his experiments, if it should prove reliable, is that in which the rays are concentrated at successive foci by means of lenses. On this depends the determination of their wave-lengths. These foci were observed by the methods described above, and other observers have failed in attempting to repeat the experiment.

Additional confusion has been created by Blondlot's most recent work, which seems to indicate that the wave-lengths of the N-rays instead of being longer than the longest or infra-red light rays are shorter than the ultra-violet or shortest known rays. He has shifted them from one end of the visible spectrum to the other.

What then is the situation? Briefly this: Blondlot's claims, if substantiated, are of the first importance. The bases of these claims are not, however, generally accepted by other physicists. Since criticism has arisen he has attempted to repeat his experiments, and has obtained results inconsistent with his earlier work. Some of his simpler experiments have been corroborated by certain physiologists. In view of his standing and ability as a physicist, no hasty conclusion should be drawn until he has been heard from further. He must, however, make consistent repetitions of his experiments, and with a more reliable measuring instrument than the eye, before they can now be accredited. It is "up to" Blondlot.

High-Speed Steam Railway Service.

It is reported in the *Electrical Engineer* (London) that, as an indirect result of the Marienfelde-Zossen high-speed railway trials, experiments are now being made on a number of German railway lines, with a view to investigating the working conditions of steam railway service at increased speeds. On the Cassel-Hanover line, trains tested are made of large high-speed locomotives and solidly connected six-axle cars, warranting a mean speed as high as eighty-one miles per hour. If these experiments result satisfactorily, it is thought probable that next summer some specially suitable lines will be arranged for an increased speed service, as the Berlin-Zossen trials have shown the existing permanent ways to be fully suitable for a similar service.

An Engineering Building.

After the American Society of Civil Engineers declined to cooperate in accepting the building which Mr. Andrew Carnegie offered to erect for the national engineering societies in New York city, some doubt existed as to the outcome of this action. It was not known whether the offer would still hold good so far as the other societies were concerned. This doubt is now set at rest by the following letter from Mr. Carnegie:

March 14, 1904.

Gentlemen of the Mechanical Engineers, Institute of Mining Engineers, Institute of Electrical Engineers, Engineers' Club of New York:

It will give me great pleasure to devote, say, one and a half million of dollars for the erection of a suitable Union Home for you all in New York city. With best wishes.

Truly yours,
(Signed) ANDREW CARNEGIE.

The three engineering societies named and the Engineers' Club have, with the unanimous approval of all members, taken active steps toward accepting this generous gift thus offered by one whose career is so intimately connected with the development of industrial arts in America. The total sum involved is about $2,500,000, for in addition to the $1,500,000 given by Mr. Carnegie, the investment in land for the three societies on West Thirty-ninth street, between Fifth and Sixth avenues, represents over $500,000, and the Engineers' Club has also acquired valuable land for its own purposes on West Fortieth street. This lot faces the New York Public Library.

The engineering building will probably be twelve stories high, and it will be designed with a view of meeting the requirements of the societies. The three societies mentioned will have headquarters there, and several kindred bodies have already made requests for accommodation. There will be four or five auditoriums, differing in size, one large enough to seat from 1,200 to 1,500 people. All will be fully equipped for scientific meetings and lectures. There will also be an engineering museum and a library hall where the libraries belonging to the different societies will be grouped. Each section will be administered by its respective librarian, and to each will be added literature relating to its own branch of work, so that duplication, both of books and periodicals, will be avoided. It is purposed to cooperate with the New York Public Library, and it is hoped that in this way there will be made available here the most complete library of engineering and technical literature in the world. The libraries of the three societies at present include about 50,000 volumes.

Each society will maintain its identity and will have its own rooms in the new building, which it is hoped will be ready in 1906. The three societies have to-day over 9,000 members, and the rate of increase is between ten and fifteen per cent annually. Their total income is about $135,000, while in assets of all kinds they have property to the value of between $250,000 and $300,000. This sum is rapidly being increased by gifts from members.

The other technical societies which desire quarters in the building represent a body of over 500 members, engaged in all branches of civil, mechanical, electrical, municipal and other branches of engineering. Although the building will be large, having a frontage of 125 feet, it seems probable that, from the start, it will be fully occupied.

The Engineers' Club building, which will adjoin the other, will be controlled independently, but will use the same sources of light, heat and power. This club has recently increased its membership to 1,200, and has a long waiting list. Its annual income is about $120,000. The two buildings, which will adjoin and face the opposite streets, will harmonize architecturally.

While Mr. Carnegie is providing the building, the three societies will provide the land, but, in the meantime, Mr. Carnegie has acquired it for them. The leases now running expire on July 1, and work will then begin and be pushed to completion as rapidly as possible, plans having already been drawn. The representatives of the four bodies interested as direct beneficiaries and trustees of Mr. Carnegie's gift to engineering are as follows: American Society of Mechanical Engineers—Professor F. R. Hutton, C. Wallace Hunt, J. M. Dodge. American Institute of Mining Engineers—Dr. A. R. Ledoux, Theodore Dwight, C. Kirchhoff. American Institute of Electrical Engineers—C. F. Scott, Dr. S. S. Wheeler, Bion J. Arnold. The Engineers' Club—J. C. Kafer, W. H. Fletcher, T. C. Martin. These members have acted as a conference committee, and have had charge of the matter throughout the early stages. They are now at work on the details.

A Modern Railway, Light and Power Plant.

The Reconstruction of the Property of the Zanesville Railway, Light and Power Company, of Zanesville, Ohio.

IN SEPTEMBER, 1902, Messrs. Rudolph Kleybolte & Company, bankers, of Cincinnati, New York and Chicago, entered into a contract for the reorganization of the finances and the rebuilding of the property of the electric light and street railway company of Zanesville, Ohio. Subsequently a contract was made with H. M. Byllesby & Company, of Chicago, Ill., for the engineering work. This was carried out by the company through one of its engineers, Mr. E. C. Braun, who was made resident engineer. Mr. Braun was assisted by Mr. W. A. Gibbs, the general manager of the property.

For a year previous to the reorganization of the property—that is to say, the year which ended September 1, 1902—the electric railway had shown a gross income of $80,000, and the electric light company a gross income of $50,000. Although the improvements described in this article have only been completed within the last two months, and during the year just closed the property has been running, for the bulk of the time, without the benefit of these, the gross earnings for the railway for the year reached $100,000, and the gross earnings of the electric light and power company $65,000.

The old power-house of the company consisted of a multiplicity of belt-driven generators, with one direct-connected high-speed unit of 200-kilowatt capacity, and one compound belt-driven unit of 200-kilowatt capacity, series arc machines and horizontal return tubular boilers. All of this property is now being sold, and the station is being operated from the new power-house.

The new power-house is located on a strip of land bound by the United States Government canal on one side, the Muskingum river on the opposite side, by the Baltimore & Ohio railway bridge on the north, and by a concrete "Y" bridge on the south.

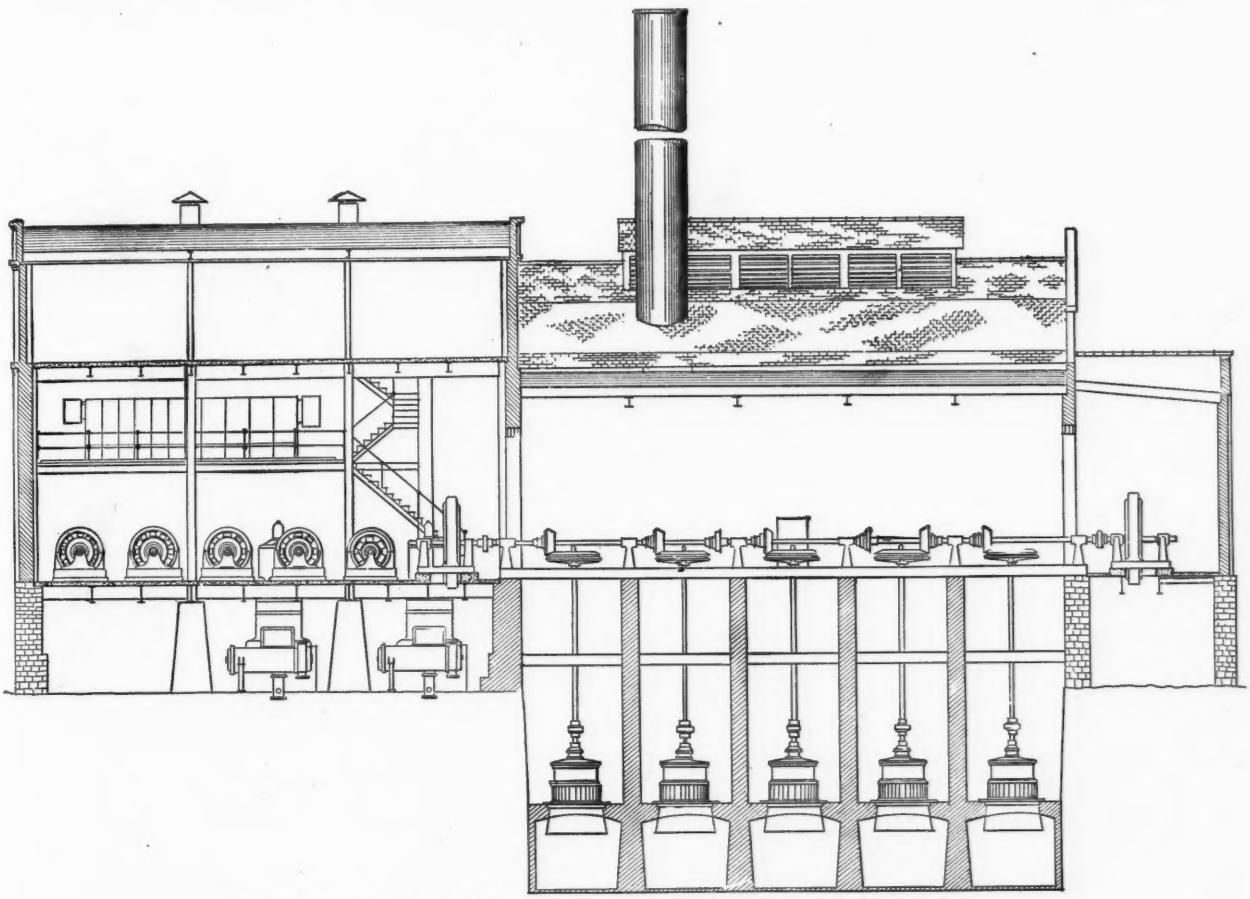


DIAGRAM OF NEW POWER PLANT, ZANESVILLE RAILWAY, LIGHT AND POWER COMPANY.

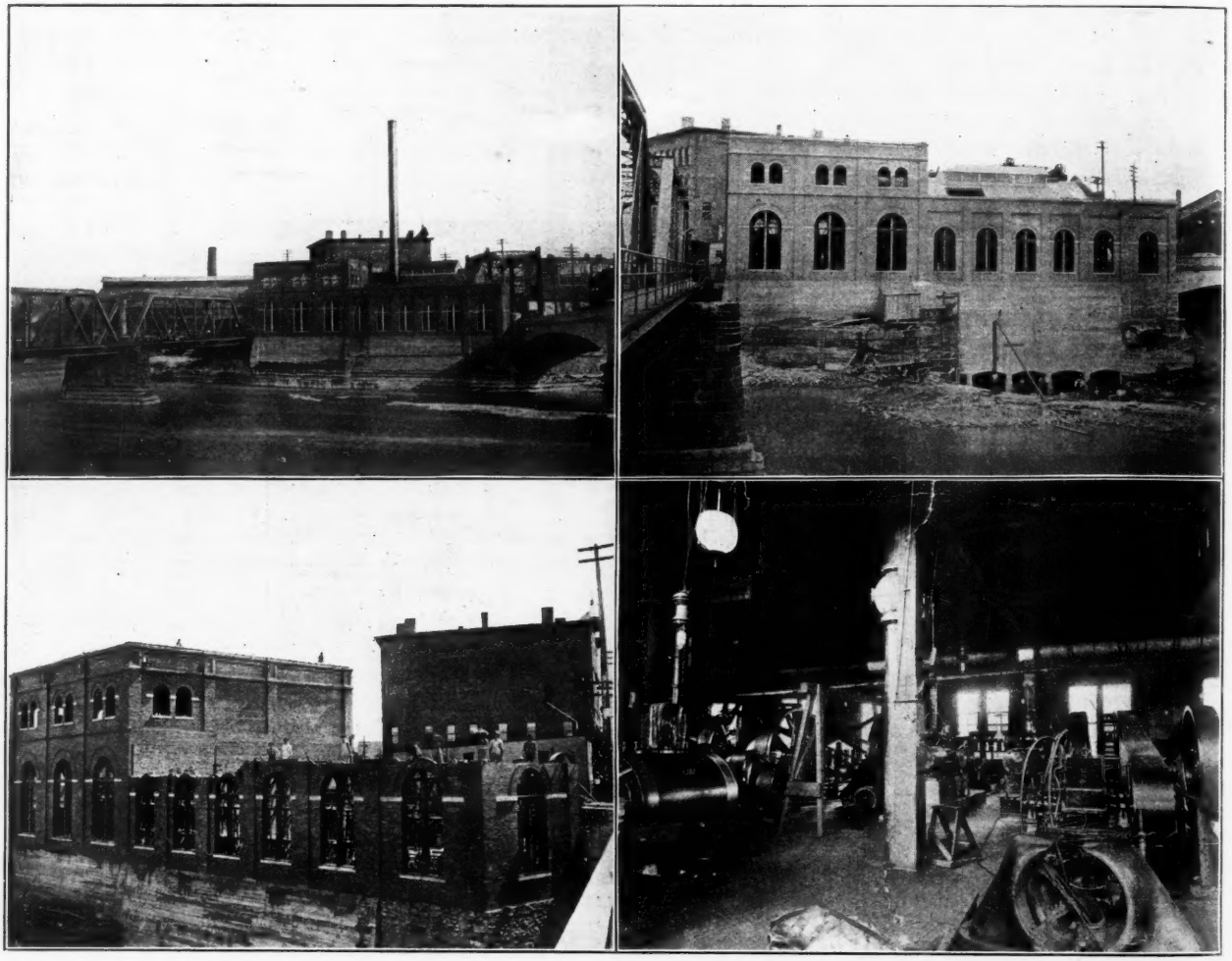
NEW TYPE OF CAR NOW USED AT ZANESVILLE, OHIO.

Zanesville is one of the oldest towns in Ohio, and the population served by the railway, light and power company is 28,000. The improvements have embraced the regauging of the entire railway system from its former five feet two inches to four feet eight and one-half inches, the rebuilding of a large part of its track, and the addition of about five miles of extensions. The new power-house which has been completed, and which the accompanying illustrations present in several details, has been designed with a view of producing the greatest economy in the service, and the engineers have utilized

the most modern equipment in building a compact and substantial power station.

The Muskingum river is a slack water navigation stream, and the United States Government maintains at its own expense a crib dam at Zanesville, located immediately above the new power-house. The railway, light and power company has obtained by lease from the government the right to use the surplus water not required for navigation. This river is an extremely fluctuating stream, and while the normal head obtained at the new power-house is thirteen feet, this head frequently disappears entirely, due to high water. These fluctuations render it impossible to rely solely upon the water power, and therefore the power-house is equipped with a complete steam plant. The carefully made readings of the Muskingum river by the United States Government engineers, extending through a period of twenty years, however, justified the belief of the engineers that they would be able to furnish approximately fifty per cent of their total output by means of water.

To utilize the water power there have been installed five Stilwell-Bierce fifty-one-inch Victor water-wheels, driving through suitable cutoffs clutches onto a main horizontal shaft. At each end of this shaft there is a direct-connected, 375-kilowatt, sixty-cycle, alternating-current generator. The battery of five water-wheels is controlled by two Lombard water-wheel governors which are electrically operated from the main switchboard.



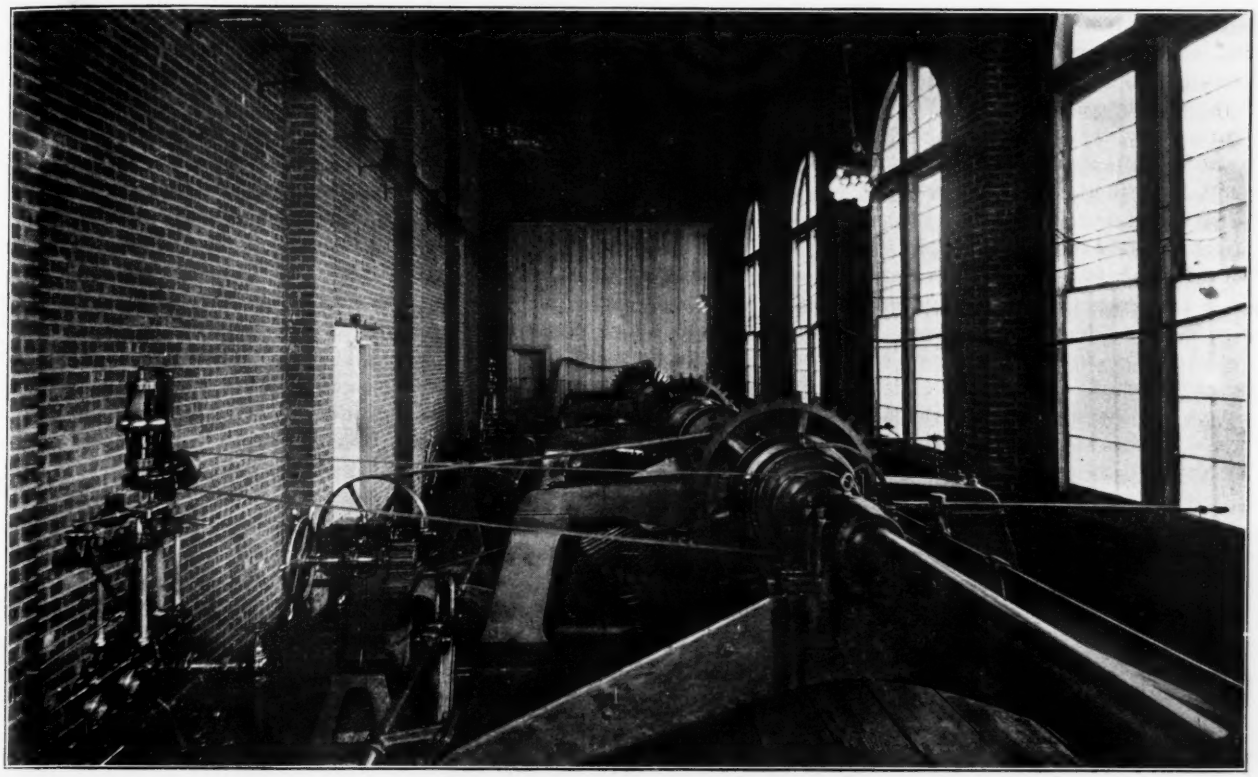
1.—General View of the Zanesville Station. 2.—View from B. & O. Bridge, Showing Arch Construction over Tail-Race. 3.—View of Power-House, under Construction. 4.—Interior of Old Power-House.

In addition to the water-wheel plant there are two General Electric steam turbines of 500-kilowatt capacity each. These are supplied from a battery of two Heine water-tube boilers of a rated capacity of 380 horse-power each. The steam from the turbines is condensed by a surface condensing outfit manufactured by the Stilwell-Bierce Company, of Dayton, Ohio.

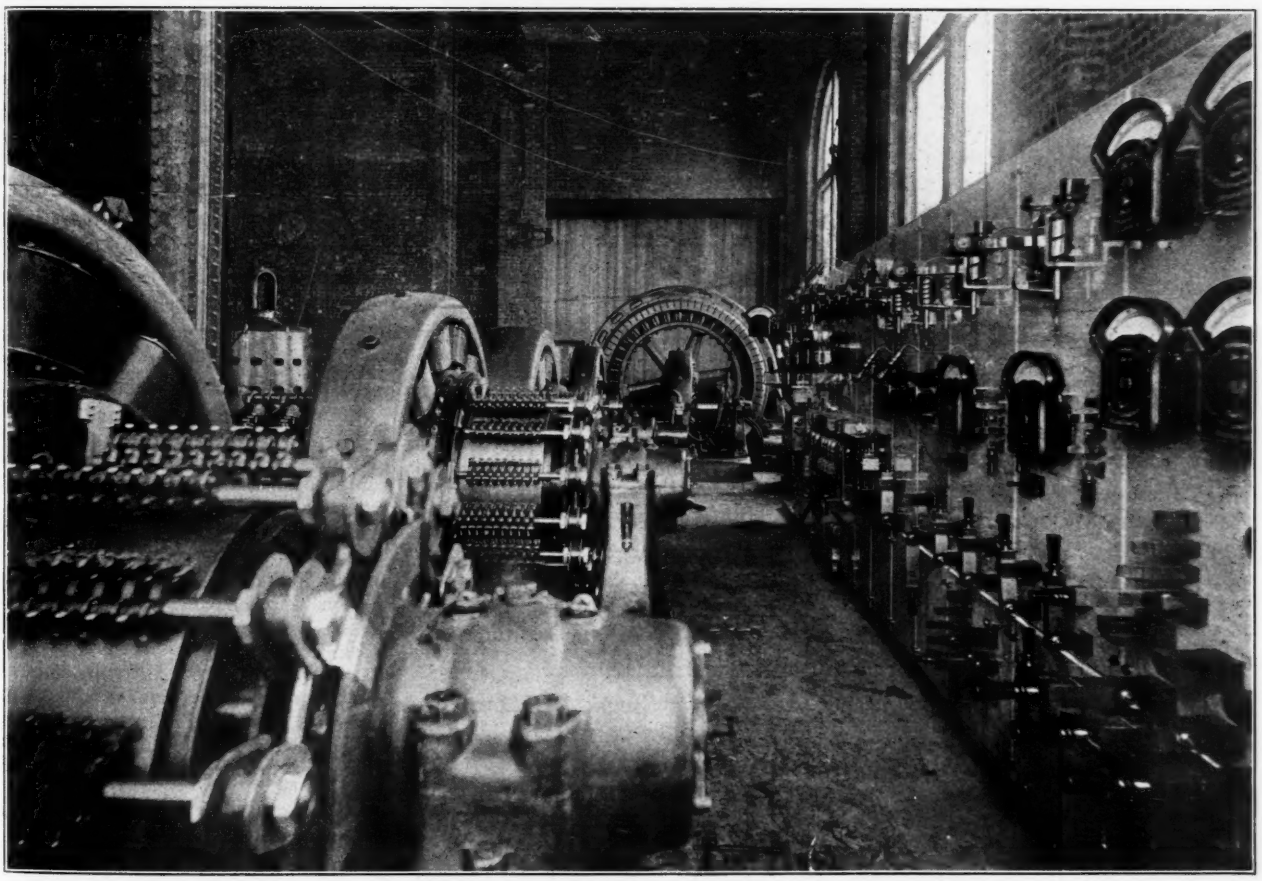
All of the direct-current switchboards are on the main floor of the engine room, and the high-tension alternating-current switchboards are on a gallery, underneath which runs a switch connecting the Baltimore & Ohio tracks on one side of the station and the city railway tracks on the other side. The rotaries, both for the railway and for three-wire use, were made by the General Electric Company, and are of the six-phase type, supplied through air-cooled three-phase static transformers of 330-kilowatt capacity each. The air-blast for cooling the transformers is supplied by two Buffalo Forge Company's electrically driven fans.

The station is built to generate its entire output of current by sixty-cycle alternators at 2,300 volts. This enables any one of the generators, by means of rotary transformers, to be operated at will or combined upon the street railway load and three-wire lighting system which is used in the body of the city, as well as the alternating-current light and distribution system for outlying districts.

In order to use the water turbine plant as much as possible, a storage battery equipment had been added. It frequently happens that while the street railway is



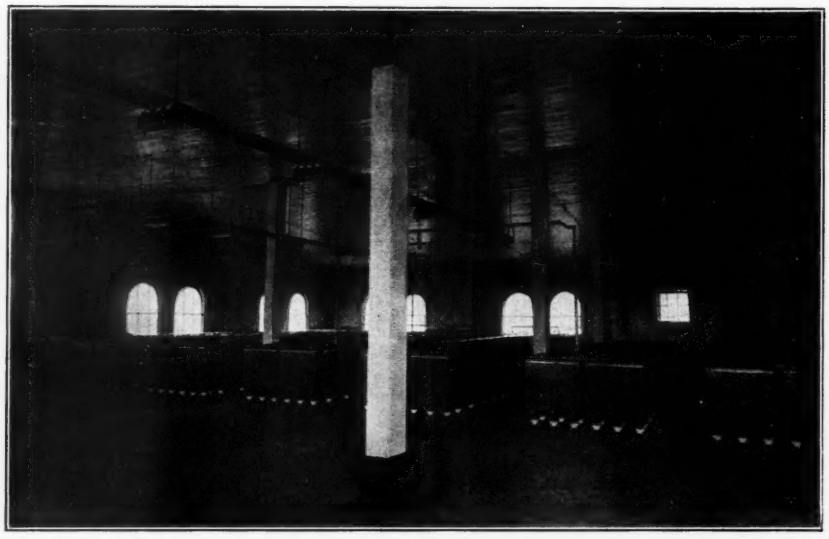
WATER-WHEEL ROOM, ZANESVILLE RAILWAY, LIGHT AND POWER COMPANY.



DIRECT-CURRENT SWITCHBOARD AND ROTARIES, WITH 375-KILOWATT ALTERNATOR IN BACKGROUND, ZANESVILLE RAILWAY, LIGHT AND POWER COMPANY.

requiring an average load of 225 kilowatts, it has extreme peaks, due to the fluctuating load of the local street service, and the periodic passage of the Newark interurban cars, which raise this to 750 kilowatts. While there is sufficient water power to furnish the full average power required by the street railway, there is not sufficient to handle these peaks, but by the use of the storage battery it has been found possible to operate the average load and the peaks when the actual amount of power obtainable from the water is less than 300 kilowatts. This storage battery is situated on the upper floor of the station, and consists of 264 cells of chloride accumulators. Each cell contains seventeen type G plates, and the tanks are large enough to stand a fifty per cent increase when the demand for power requires it.

It is often possible to secure a sufficient supply of water to operate the entire station with the help of the storage battery. In all periods, except those of extreme high water, the steam end of the station can be shut down entirely during the time that the street railway is not running—from about midnight to five in the morning.



Storage Battery Room, Zanesville Railway, Light and Power Company.

The company is installing the General Incandescent Arc Light Company's system to handle its municipal contract, which calls for 275 city lights.

Of the total railway there is about seven miles through brick-paved streets and about seven miles through macadam and dirt streets. Seventy-pound steel rail is used throughout, of standard section in the macadam and dirt streets, and of deep section in the brick paving.

The rolling stock of the company has been increased by ten Brill cars, equipped with Brill double trucks and four General Electric twenty-five horse-power motors. These cars are thirty-eight feet overall, and are provided with ample vestibule capacity.

The new power-house is absolutely fireproof throughout, and is built upon a ledge of rock, the substructure being entirely of concrete, and extending up to a point above maximum high water. The superstructure is of Ohio pressed brick. The roof is of slate with copper flashings. All of the floors are of steel I-beam and concrete construction, and the portion of the station building containing the water-wheels and the boiler house is supported over the raceway on built-up iron columns entirely embedded in concrete, in accordance with the most modern practice.

The boiler room is of ample capacity for accommodating another duplicate battery, and there is ample space left in the engine room and basement for the addition of 1,500 kilowatts in steam turbines and their attending condensing and auxiliary apparatus. The battery room also, in addition to the present equipment, has vacant space left sufficient to accommodate a three-wire battery for further additions to the railway service when this becomes necessary. The storage battery is equipped with an emergency panel and suitable connections, so that it can be at once disconnected from the street railway and thrown on the three-wire service.

Notes on Steam Turbines.

In a paper read by Mr. William Chilton before the Manchester local section of the British Institution of Electrical Engineers on the Brush-Parsons steam turbine, the author described the type of construction adopted, and gave curves showing the efficiency of performance of this engine. The method of securing the blades in the rotor of the cylinder is effective and cheap. The blades are drawn to the correct section from a special mixture of brass or from copper in lengths of twelve to fifteen feet, and cut to the required length. Grooves about one-quarter of an inch deep are turned circumferentially on the outer surfaces of the rotor and on the inner surfaces of the cylinder. The blades, after being cut to the correct length, are placed in the grooves in a radial direction. The width of the grooves is regulated so that when the blades are in place they take up their correct angular position relatively to the axis of rotation. Caulking pieces of soft drawn brass, and of a length equal to the depth of the grooves, are placed in the grooves alternately with the blades. The caulking pieces are then tightly caulked home into the groove with special tools. When finished, the whole forms a piece of sound work, very well adapted to the function it is to perform.

To keep the moving blades always in correct relative position to the guide blocks, and also to take up any small unbalanced force, the thrust block at one end is split. This is divided horizontally. The lower half is fixed, and the left faces of the thrust collars on the spindle bear against the right faces of the lower block. The upper block can be set to the left, so that the right-hand faces of the collars bear against the left faces of the upper block. The rotor is thus prevented from moving either way. In a comparison of a reciprocating engine with a turbine of this type, each rated at 500 kilowatts, and run condensing, the engine is charged with twenty-five pounds of steam per kilowatt-hour, and the turbine, with twenty-two and one-half. The extra cost of the turbine plant is stated to be 2.7 per cent more than that of the reciprocating.

In the discussion of this paper, Mr. F. H. Whysall gave some information concerning the two 1,800-kilowatt Parsons continuous-current turbo-generators installed at the Dickinson street works of the Manchester (England) Corporation. These were compared with the reciprocating engines in the adjacent Bloom street station, which have the same rating. The steam consumption for the turbine at full load and 125 pounds pressure, saturated, was 19.59 pounds per kilowatt-hour. For the reciprocating engine at 156 pounds, saturated, the consumption was 19.83 pounds. The capital cost of the turbine plant, less foundations, and including condensers, was, per kilowatt-hour, £8 3s. ($39.50). For the reciprocating engine it was £10 ($48.60). Although the turbine saved in oil, the cost of the turbo-generator brushes outweighed this. Copper brushes are used, and the commutator speed is 6,000 feet per minute.

HIGH-TENSION TRANSMISSION PAPERS AT THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

INTRODUCTIONS TO DISCUSSION.

At the meeting of the American Institute of Electrical Engineers, to be held at 108 West Fifty-fifth street, New York city, on March 25, 1904, the subject of high-tension transmission will be taken up. A number of papers have been contributed as introductions to discussion for that meeting. The following are abstracts of these papers. These introductions are written in order to provoke discussion, and all those connected with the Institute and desiring to take part in the discussion may do so by being present at the meeting or by sending in a written "contribution." These contributions should be mailed to Ralph D. Mershon, 29 Broadway, New York city, so that they will be received not later than March 19, 1904.

THE RELATIVE FIRE-RISK OF OIL AND AIR-BLAST TRANSFORMERS.

BY E. W. RICE, JR.

I think it will be admitted that in general that type which contains the greater quantity of inflammable material will occasion the greater fire hazard. The inflammable material in an air-blast transformer of, say, 1,000-kilowatt capacity will amount to about 800 pounds; in an oil-cooled transformer of the same capacity the amount will be about 7,300 pounds. While this comparison can not be taken as a measure of the relative fire risk, it is an indication to be considered, especially in view of the fluidity, the low temperature of ignition and high calorific value of oil.

While the quantity of inflammable material in an air-blast transformer is, as stated, relatively small, it has an extended surface exposed to a large volume of air, and, therefore, if a fire starts from internal causes, such as short-circuit or extreme overload, is capable of rapid combustion. This combustion could be checked by shutting off the flow of air to a transformer by means of a diaphragm automatically closed by the melting of a fusible link, the fusible link so located as to be melted by the first contact with flame; a method similar to that employed for closing firedoors in buildings.

An oil transformer, properly cooled, is probably not particularly subject to ignition of the oil from internal burnouts or arcs. It is well known that oil is an excellent medium for the smothering of alternating arcs, and this principle is utilized in connection with oil switches.

The vapor above the oil may, however, be ignited by electrical discharges. Even in this case, while the quantity of combustible material is enormous, the surface exposed is relatively small. The principal fire hazard in an oil transformer is due to the large mass of inflammable liquid material which under certain conditions may become totally consumed. It becomes a special hazard in the case of fire from sources external to itself.

Considerations of first cost, economy of space, simplicity, operating costs, etc., have resulted in placing transformers in the same room with switchboards and other apparatus, such as synchronous converters, motor-generators, etc. Under such conditions it would seem that the air-blast transformer constituted the lesser fire risk than the oil transformer, and would therefore be generally employed if the fire risk were the only consideration. The air-blast type, however, is limited in practice to pressures of about 30,000 to 35,000, as the static discharge which occurs at much higher pressures would in time break down the insulation. It is therefore necessary to employ oil insulation on the higher pressures now common.

The fire risk can be practically eliminated by placing such transformers in a room or rooms separated by suitable firewalls from the other part of the plant. This plan has already been proposed and introduced. An entirely separate building, subdivided again into suitable rooms, may be employed where the maximum of safety is demanded. Much may be done to limit the risk, even when the transformers are placed in the same room with other apparatus, by proper systems of piping for drainage of the oil away from the building, by placing the transformers in a depressed area of concrete arranged for rapid drainage, etc. Of course, any of the methods commonly employed for preventing, limiting or extinguishing oil fires may properly be employed.

THE USE OF GROUP SWITCHES IN LARGE POWER PLANTS.

BY L. B. STILLWELL.

The group switch first appeared in the plant of the New York Street Railway Company at Ninety-sixth street, but as the writer had nothing whatever to do with the design of that plant, he selects for consideration the plant of the Manhattan Railway Company. In this plant two complete sets of main bus-bars are used. Switches are provided by means of which each of these sets may be divided into two independent sets of bus-bars to each of which four alternators and four groups of feeders may be connected. Eight group switches are provided, through each of which current is supplied to a set of auxiliary bus-bars, to which in turn the individual feeders are connected through their respective switches. One of the eight feeder groups is used to supply power to auxiliaries in the power-house. The other seven groups supply power, respectively, to the seven substations which receive power from this central source. All switches in the high-pressure alternating-current circuits are of the motor-operated oil type.

The arguments in favor of the group switch as used in the plant of the Manhattan Railway Company are:

1. It affords an additional means of opening a feeder switch that fails to open its circuit, when operated for that purpose. The advantages of the group switch in respect to this function to-day appear materially less than they did five years ago, for the reason that the power operated oil switch within the period named has demonstrated a high degree of reliability. However, it can not be assumed that the feeder switch is invariably reliable, and, therefore, judgment of the weight of the argument in favor of the group switch, based upon its use as a reserve for the feeder switch, becomes a question of judgment of the chances of failure of the feeder switch on the one hand and the seriousness of total interruption of power supply on the other.

2. It affords means of reducing aggregate load upon the power-house in case of necessity, more rapidly and otherwise less objectionably than the usual method of cutting off individual feeders. It will sometimes happen in the operation of a power plant that it becomes necessary suddenly to shut down one of the generating units. If the load carried at the time be such that the shutting down of the generator implies reduction of the external load, this can be accomplished most conveniently by operating one or two group switches.

3. Where duplicate main bus-bars are used it facilitates transfer of load from one set to the other, in case it becomes necessary suddenly in operation to make such transfer. As bus-bars and connections are now installed in our best plants, this necessity does not arise frequently; nevertheless, it is liable to occur, and obviously half a dozen group switches may be used to effect the transfer in much

less time than would be required were five or six times that number of individual feeder switches used.

4. The grouping of the external feeder circuits in group units bearing a simple fixed relation to the generator units establishes a symmetry and proportion most useful to the operator, particularly in times of emergency. In the case of the plant under consideration, at times of full load, the power passing through each group switch is substantially equal to the output of one generating unit. This relation of course does not exist under partial loads, but under such loads it is not difficult usually to keep in service generating capacity exceeding the load by a margin sufficient to make it possible to shut down one generator without cutting off feeders; and in cases where this margin of capacity is not kept in service it is, nevertheless, a more speedy and certain operation to cut off the necessary number of groups of feeders than it would be to cut off a proportionate number of individual feeders.

The arguments against the group switch are:

1. It introduces additional apparatus and, therefore, in itself increases the risk of interruption due to failure in switch insulation, etc. The successful operation of many plants, particularly in America, has been interfered with by the introduction of too much switch gear and too many safety devices, automatic and other; these additions in themselves being responsible in some cases for more trouble than they prevent; and it is to be noted that the group switch implies the auxiliary bus-bar. Here again it is impossible to dogmatize, for as the result of additional experience, the judgment of to-dav may be reversed five years from now. As an expression of personal opinion, however, I may say that if the group switch and the auxiliary bus-bars be reasonably well insulated and installed, the interruptions originating in this additional apparatus should be almost negligible in the case of such a plant as that which we are considering.

2. The group switch and its bus-bars imply, of course, an increase in the cost of the plant. In case of the Manhattan plant this increase is about ten per cent of the cost of the switch gear and measuring apparatus, and about four-tenths of one per cent of the cost of the plant. To put it another way, the cost of the group switches and bus-bars for the plant approximates $20,000, and the annual cost, assuming this to be ten per cent of the investment cost, is $2,000, which is about two-tenths of one per cent of the annual cost of operating the entire plant, including substations.

In the plants in which the feeder unit equals or exceeds the dynamo unit of power, the group switch, of course, disappears. In this case, however, it may still be advisable to use two feeder switches in series in order to avoid the necessity of shutting down the entire plant in case of the failure of a single feeder switch.

Obviously, also, there is no reason for attempting to use group switches in cases where the total number of feeders is small.

For plants comparable in magnitude to the plant of the Manhattan Railway Company, using a very considerable number of feeders, the group switch is important and its use generally advisable.

OIL SWITCHES FOR HIGH PRESSURES.

BY E. M. HEWLETT.

This paper naturally compares the oil-break switch with the air-break switch. In treating this subject the following points appear to be the main points for consideration:

1. Abnormal Rise in Pressure—Owing to the fact that in oil switches the circuit is opened at the zero point of the wave, the rise of pressure found in the air-break switch is not experienced. This point is of particular importance in high-pressure, long-distance lines, and in cables carrying considerable energy.

2. Capacity—Experience has proved that oil switches may be designed to break circuits of practically unlimited capacity.

3. Length of Arc—Owing to the smothering action of the oil on the arc the length of arc under oil is only a fraction of its length in air.

4. Insulation—The insulating qualities of the oil decrease the distance required to prevent leakage and arcing.

5. Size of Switch—Owing to the fact that the arc length is materially decreased and the value of the oil as an insulation reduces the creeping surface, an oil switch can be made very much more compact than an air switch.

6. Remote Control—The design of the oil switch lends itself readily to operation by control from a distance.

7. Arc Confined—The fact that the arc is ruptured under the oil within the switch has two advantages; 1, switches can be placed close together without danger of short-circuit; 2, in case of emergency, confusion is avoided as there is no visible arc to disconcert the attendant.

8. Station Arrangement—The flexibility of the oil switch places no limitations on the station arrangement, permitting the circuits and buses to be arranged in the most advantageous manner.

9. Isolation of Phases—The possibility of complete isolation of the phases in a reasonable space is easily secured by the use of oil switches.

TERMINALS AND BUSHINGS FOR HIGH-PRESSURE TRANSFORMERS.

BY WALTER S. MOODY.

This subject will include cables, straps, connectors, etc., for both high and low-tension side, designed both for terminal connections and for changes in the ratio of transformation, together with their insulation. In transformers for moderate pressure and having but two high and low-pressure terminals, the problem of terminals is a simple one; with higher pressures and numerous changes in the ratio, however, the design of these parts of the transformer often becomes a most difficult problem upon the proper solution of which depends, to no small extent, the reliability of the transformer.

Location of Terminals on Coils—It is much better to have the high and low-pressure terminals at opposite ends of the structure, for it is almost impossible to keep safe distances between the terminal and connecting coil leads, when all are at one end. In a shell-type structure, having its coils in vertical position, this requires one set of coil terminals to be at the bottom of the case, but to bring these safely to the top is not as difficult as to separate high and low-pressure conductors that are at the same end of the windings.

Insulation of Terminals on Coils—In an oil-immersed transformer, this presents little difficulty, as it is simply necessary to have all leads rigidly spaced a safe distance from each other and from the coils, and covered with sufficient waterproof insulation to prevent any moisture penetrating the coil around the terminals before the oil is put in.

In air-blast transformers, however, the case is different; here all terminals must be covered with an insulation integral with that on the coil itself, to a distance from the coil that provides sufficient surface insulation, even when the lead is well covered with dust and dirt.

Often the dielectric strength of a transformer is materially lowered by allowing the coil terminals or taps to project beyond the sides of the coils, thus shortening the distance between the primary and secondary. "Spreading" the exposed ends of the windings removes this difficulty, except when the terminal comes from a point well within the coil, but introduces

a more serious defect, lack of rigidity to withstand the strains of short-circuits. Usually the problem can be solved by so winding coils as to have only outside terminals and locating such coils as have taps on the outside of the coil structure.

Location of Main Terminals—The best location for these naturally varies with the type of transformer and its pressure; for the air-blast type, the air-chamber forms a convenient and natural location for the low-pressure wiring, and the terminals of these are therefore usually located in the base of such transformers and made accessible by doors in the side of the base. For pressures not exceeding 25,000 volts, the high-pressure wiring can also be placed in the air-chamber, without making the air-chamber of excessive cross-section, so that all transformer terminals are in the base and exposed wiring is avoided. Heavy rubber-insulted cable is to be avoided in such construction, however, for should the rubber take fire from short-circuit or other causes a draught of air will carry the fire along the duct and into the transformers with great rapidity.

In oil-filled transformers the terminals are, of necessity, located at or near the top of the case. Often for convenience in external wiring, projecting pockets are provided through which terminal leads may leave the case in a downward direction. With such construction, it is necessary to have a solid section in the cable, just above the oil line, and to have this section uninsulated or covered with an insulation imprevious to oil, otherwise the cable and insulation will act as a siphon and discharge oil.

Insulation of Main High-Pressure Terminals—Below 40,000 volts, the insulation of terminals offers no special difficulty; porcelain or glass bushings can readily be obtained that are safe for this pressure, even if the conductor has no insulating covering. For higher pressures, the problem is more difficult, if no insulation is used on conductor, the bushings become expensive and so large that there is scarcely room on top of a moderate size transformer for as many terminals as are often required. The following are some of the more common forms of bushings that have been used:

Wooden tubes.

Hard rubber tubes.

Glass and porcelain tubes, both single and concentric.

Numerous forms of moulded porcelain bushings.

Wooden tubes of the necessary size can not be thoroughly dried and filled. Hard rubber is so apt to contain impurities that it is unsatisfactory; moreover, it deteriorates rapidly if ozone is generated near it. Glass is fragile and must be protected with other semi-insulators. Porcelain, or any smooth tube, must be very long if it has sufficient leakage surface to be safe when dirty, and even the best shapes of corrugated bushings are large and expensive when capable of withstanding a test of from 75,000 to 160,000 volts.

All things considered, the writer has found the following practice quite satisfactory for test pressures not exceeding 160,000.

Insulate the lead with varnished wrappings that will safely withstand for one minute about half of the test pressure to be applied, bringing out this lead through a porcelain bushing having the same strength as the insulation of the lead, and sufficient surface to prevent leakage at this pressure when dirty; in other words, let the insulation of the leads be sufficient for the working pressure, and the porcelain be of such strength as to give the factor of safety desired. This combination forms a far safer insulation than a bare conductor and a large bushing which would stand the same puncture test as the combination, from the well-known fact that oxidized linseed oil is an insulation that will momentarily stand several times as much as it will for any considerable length of time, while porcelain, glass, etc., have no such time-factor.

In leads requiring a test of 100,000 volts or more, and insulated in this manner, an additional difficulty is met in the induced charge on the outer surface of the insulation; at this pressure the surface is covered with a heavy brush discharge that so reduces the surface resistance to leakage that 100,000 volts will travel along several feet. It is usually impracticable to make the insulated lead long enough to withstand the pressure under these conditions, but the discharge may be broken up, so that it will not appreciably reduce the surface resistance, by bell-shaped pieces of rubber, porcelain or other insulation slipped over the lead before all the varnished wrappings are put on, and having its small end so shaped as to allow of its being burned in the outer wrappings.

In transformers designed for Y-connection and grounded neutral, some transformer builders, in order to save expense on high-pressure bushings, have grounded one terminal on the case and insulated only such leads as are to be connected to the line; this prevents operation with Δ-connections, but otherwise seems unobjectionable. In similar manner, the use of three-phase transformers with the interconnecting between the phases made within the case reduces the expense and possibility of trouble with bushings.

Eighty thousand volts is the highest pressure that is now practicable for transmission work, but transformers and insulators must be tested, consequently there is some demand for transformers working up to 200,000 volts. The insulation of the terminals of such transformers is the most formidable part of their design. As yet, I know of no satisfactory solution of the problem except to use oil-filled tubes as terminals. A terminal that has withstood 375,000 volts without any indication of weakness is constructed as follows:

The tube was the shape of two truncated cones, bases together; about twelve inches in diameter at the centre, and four inches at either end; it was built up of thin wooden rings, telescoped a short distance into each other, and held together by the conductor, which for mechanical purposes was made quite heavy, and which was located in the axis of the cones and supported by washers at either end of the tube; between each section of the tube were collars of insulating material, some three inches larger in diameter than the tube which served the purpose of greatly increasing the leakage surface. After the sections were drawn tightly together by nuts at each end of the conductor, the whole structure was repeatedly dipped in varnish and dried, thus sealing all joints. The terminal was mounted with the lower end several inches under the oil in the transformer and with its largest diameter on a level with the cover; the lower end of the tube was tightly sealed, making the tube perfectly oil-tight.

Internal Terminals—At present we are passing through a period of development in line construction. Each engineer of a new transmission system of considerable length desires to use as high pressure as possible, with a line contruction of reasonable cost, but few are sure whether 50,000, 60,000, 70,000 or 80,000 volts is the safe maximum for their conditions. It is common, therefore, for the manufacturers to be asked to make transformers that can be operated at several voltages on the high-pressure side. The result, whether accomplished with series-multiple connection, changing from Δ to Y, or simply by taps, usually requires so many terminals that it becomes quite impracticable to place all the necessary leads outside of the case, even where it is desirable to do so; consequently, accessible terminals inside the case must be

provided. Again, at these and lower pressures, also, it is usually desirable to provide for limited range of adjustment in the ratio, say, by two per cent, with a total of ten per cent; such changes are usually too small to be made except by means of taps on the high-pressure windings. Except in transformers of very large capacity, there would be no room safely to insulate numerous terminals above the surface of the oil; the practice is therefore to locate such terminals just under the oil and make them as accessible as possible, either by removing the transformer top, or through an auxiliary cover on the top of the case. It is better that each of these terminals be separately supported by glass or porcelain insulators, for a single support, such as a slab of marble, is almost sure to collect sufficient semiconducting material to cause trouble sooner or later. Such terminals being, at the best, rather inaccessible, there is danger that a wrong or imperfect connection will be made when changes are desired; the following method of mounting transformers in the tank greatly simplifies the problem of getting at such terminals, especially when transformers are installed under a crane. Instead of supporting the transformer proper on the base of the case as usual, it is hung from a strong cover; the interior terminals are placed in about the usual position, but are supported by the bolts carrying the transformer. To get at these terminals it is then simply necessary to raise the cover with the transformer, until the terminals are on a level with top of case; connections may then be made with convenience and safety and the transformer returned to its position in the tank.

Low-Pressure Terminals — Usually these present no special difficulties; when transformers are connected in multiple and deliver 500 amperes or more, special caution should be taken that all joints are soldered or that terminals are of such construction as to have extremely low contact resistances. Taper plugs and receptacles are perhaps the most reliable form of contact for the purpose.

Current in excess of 500 amperes should never be brought out through separate openings in the case, otherwise there will be local heating around the terminal and needless reactance introduced into the circuit. Currents over 2,500 amperes should be brought out by means of intermixed bus-bars for the same reason.

Boston Branch of the American Institute of Electrical Engineers.

A meeting of the Boston branch of the American Institute of Electrical Engineers was held on Wednesday, March 2, in the Lowell Building. An illustrated lecture was delivered by Mr. H. A. Morss, of the Simplex Electric Company, on "The Manufacture of Insulated Wires and Cables." The speaker made a number of suggestions regarding specifications for wiring cables. Chairman Charles L. Edgar explained the movement in Boston toward centralizing all local engineering bodies.

A Chinese Telephone Sign.

The Orientals are great users of the telephones both in this country, where they are extensive patrons of the pay stations, and in their own lands, where the installations are on a large scale when their business methods are considered.

The Japanese have large telephone offices in their principal cities, and the Chinese are developing in the same direction although somewhat conservatively.

The King of Abyssinia has recently caused telephone lines of great length to be laid from the capitol to the principal cities so that he can personally communicate with the principal district rulers.

The telegraph is not adapted to any alphabet but those of enlightened nations using a relatively small number of letters, and for the Oriental alphabets the messages must be translated into a modern language and thence on receipt interpreted back into the original. This frequently gives rise to errors of a serious nature. But with the telephone the fact that the sender comes into personal contact with the recipient even to recognition of the tone of voice does much to rob the plant of the supernatural mysteries and to allay the suspicion which they always associate with the unknown. In fact, the personal contact of recognizing the small voice through the line is ascribed to good genii and the telephone lines do not receive the prejudice which are ascribed to other electric lines.

A short time ago a Chinaman walked into a telephone office which was near the Chinese quarter of an American city and when one of the men asked him to write "telephone office" in Chinese characters in a record book his manner at once changed, the imperturbable Oriental blankness of expression giving way to the most genial smiles, and he at once began shaking hands with himself and, bowing very deeply, backed out of the room. In a short time he returned and brought a strip of red paper covered with gilt spangles which he fastened to the book very neatly and then from his sleeves taking a bamboo brush and with a bamboo inkstand which was slung at his waist by a long cord reaching around his neck, he very quickly and neatly inscribed the following five Chinese characters on the red paper, and in like manner bowed out of the room:

New Chang Dialect.	Mandarin Dialect.		English Translation.
KO	CHIANG	講	SPEAK
DEN	TIEN	電	LIGHTNING
OU	YIN	音	SOUNDS
KO	KUG	公	PUBLIC
SHEE	SZŬ	司	COMPANY

"TELEPHONE OFFICE"—AS WRITTEN BY A CHINAMAN.

When these peculiar actions were explained to the Orientalist who gave the translations it was stated that with the Chinese two different codes govern their lives, one being the commercial and the other the social code. With the commercial code all writing must be on white paper, and with the social code red paper is used which is further enhanced by gilt spangles whenever the highest compliment of prayers for good luck is to be added. When this Chinaman was asked a favor by a white man, probably for the first time, the relations at once changed from the commercial to the social code, and whenever this inscription on the book has been shown to other Chinamen they at once recognize its status and begin smiling, shaking hands with themselves, bowing and smiling as was done in the first instance when the favor was requested.

A Signal Clock Wanted.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

Having written to nearly every firm handling clocks, and having the jewelers do the same, without success, I ask if you can give me the addresses of some firms which handle a clock such as is used in hotels, called the "reminder clock," which gives a signal each fifteen minutes as required.

F. T. LESSER.

Philipsburg, Pa.

SUGGESTIONS FOR PRODUCING HIGH-FREQUENCY CURRENTS AND SOME OF THEIR PHENOMENA.

BY EDWIN F. NORTHRUP AND ELLIOTT WOODS.

Inclination and circumstances have led the writers of this article to construct and play, rather than experiment in a logical and scientific manner, with apparatus of various forms for producing high-frequency currents. As the work has always been fascinating, and often instructive, even if not commercially valuable, it is thought a sort of narrative description of what we have done with high-frequency apparatus and how we constructed it and the phenomena we observed, would not be without interest to electricians interested in the laws and manifestations of electric forces.

The most difficult thing to realize by any artificial means is a strictly constant condition; be it a constant temperature, a constant illumination, a constant tone, a constant current or a constant motion. Nature left to herself tends ever to change, mutations being in general rhythmical. The most striking illustration of this tendency of Nature to a periodic variation which has been recently observed is seen in the action of a Wehnelt interrupter.

When one observes how a violin bow drawn smoothly over the string starts it into vibrations, or how a wet cork rubbed upon a window pane produces a shrill note, or a rotating wheel slightly out of balance sets up violent vibrations, and many other similar phenomena, the action of a Wehnelt interrupter, which acts upon the constantly applied electromotive force to throw the current into rapid pulsations, could certainly have been expected and might have been prophesied.

The movements of electricity in Nature as seen in lightning, in earth currents and in Northern Lights, are fluctuating or oscillating motions. It has been by the exercise of special ingenuity that, through artificial means, direct and constant electric currents have been obtained.

When an electric current flows with perfect uniformity in a circuit the concomitant phenomena are few indeed compared with the phenomena which arise when the current becomes a changing current, varying in magnitude or alternating in direction. A constant direct current is uniformly distributed over the cross-section of the wire, its external inductive effects are nil, and special contrivances must be employed to make evident its very existence. Alternate the current, the more rapidly the more striking the phenomena, and numerous effects external to the circuit are observed. The current is no longer evenly distributed over the cross-section of the wire, but crowds toward its surface until, when the variations are rapid enough, a tube having a thin wall will convey as much energy as if it were a solid rod. With the direct constant current the flow of the current can be calculated by Ohm's law. When the current alternates slowly the calculation can still be made by substituting impedance for resistance, but when the alternations reach a frequency that obtains when the electricity swings freely to and fro in the circuit, exact calculations can no longer be made, as the energy is escaping from the circuit by heat, by radiation and by other paths.

The reason that the study of high-frequency or oscillating currents is so fascinating and instructive lies in the fact

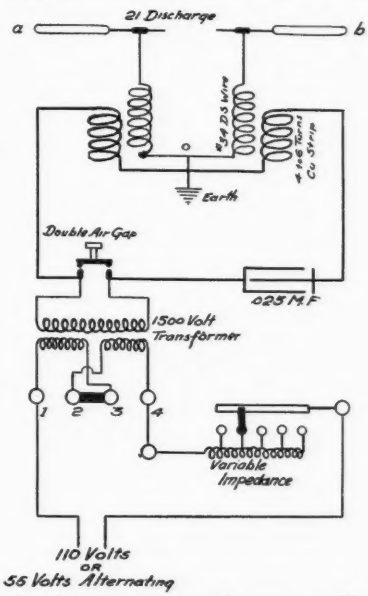


FIG. 1.—ARRANGEMENT OF CIRCUITS FOR HIGH-FREQUENCY MACHINES.

that the complexity of the phenomena which are observed forbids and makes impossible prophecies of what will happen by the aid of calculations. As we change the apparatus and vary the conditions under which we work, pleasant surprises are in store and the electrician, if he will make progress, must drop his calculus and become the observant experimenter. The writers have tried a large number of forms of apparatus and different arrangements of circuits for obtaining currents of high frequency of both low and high potential. In this article we shall confine ourselves to describing only one or two forms of apparatus and arrangements of circuits which gave best results.

The experiments of the writers have been confined to the obtaining of oscillating currents by means of the sudden disruptions of an air-gap, though there are other methods by which the equilibrium of the electricity can be disturbed and strong oscillations be obtained. In describing how the writers recently constructed a high-frequency high-potential apparatus, giving a discharge of great volume and over twenty inches in length, the essential features of design and the precautions which must be observed to obtain the best results will be brought out. It should be stated that equally good results might possibly be obtained in a number of other ways, and that the particular method adopted is only that which appeared best to the writers from theoretical considerations and many trials of different forms of apparatus.

It should be stated at the outset, and emphasized, that for obtaining the most powerful and continuous oscillations it is never necessary to resort to any device, such as a magnetic blowout, a blast of air or a mechanical contrivance for making and breaking the circuit, for disrupting the arc which, with improper arrangements, tends to form in the air-gap, weakening or destroying the oscillations. Though there are several methods by which fairly good results may be obtained, by using a source of direct electromotive force, a source of alternating electromotive force of 55 or 110 volts and of about 7,200 alternations is much to be preferred, and for the most powerful effects is necessary. There are five essential parts of a high-frequency apparatus of high potential. First, a variable impedance having as little ohmic resistance as possible and capable of carrying twenty-five or thirty amperes. This is best made by winding No. 8 wire on a core of soft iron wires. This core may be twelve inches long and two to three inches in diameter. The impedance can be made variable by bringing out any number of tapoff points, so that more or less of the turns of the winding may be used. Second, a transformer which will raise 110 volts to about 10,000 or 15,000 volts. This transformer should have a closed magnetic circuit and should be able to deliver at least two-tenths of an ampere from its high-tension winding. Third, a condenser of sufficient capacity and of dielectric strength sufficient to withstand the strain put upon it when a discharge is passing across a parallel discharge-gap of three-quarters to one inch in length. Fourth, a properly constructed double parallel discharge-gap. Fifth, a high-frequency induction coil. The last three of these pieces of apparatus will be more particularly described. Next

to the proper proportioning of the apparatus, the most essential and difficult requirement to fulfil is, that all the parts be properly insulated.

The arrangement of the circuits that the writers finally adopted in obtaining the best results with the high-frequency machine that gave over a twenty-inch discharge is given in Fig. 1. The variable impedance that is shown connected in series with a 15,000-volt transformer performs a very important function. It can not be replaced successfully by an ohmic resistance. Its action may be described as follows: when the potential has risen to a point where the double air-gap breaks down, the secondary of the transformer becomes short-circuited through the low-resistance path now formed in the double air-gap by the hot gases evolved, and if it were not for the variable impedance a rush of current would flow into the primary of the transformer and a yellow flaming arc would form in the air-gap, still further decreasing the resistance of this air-gap, and prevent the condenser from again becoming charged to a high potential. The impedance prevents this formation of the arc by holding back the sudden rush of current to the primary of the transformer. The disrupted air-gap mends and the potential of the secondary of the transformer again comes upon the condenser, charging it to its full capacity. Curiously enough, varying the amount of the impedance does not appreciably affect the length of the double air-gap that will disrupt. Increasing, however, the impedance beyond a certain point, which is fairly definite, will cause the disruptions of the air-gap, when opened a fixed distance, to quite suddenly cease. When the impedance is thrown entirely out, arcing will generally take place in the air-gap, especially if the capacity of the condenser is small and the transformer a large one, and the oscillations will become very poor or cease altogether. The variation of the impedance through wide limits produces, in a marked manner, a variation of the number of disruptions in the air-gap that take place at each alternation of the electromotive force of the source, this result being made plainly manifest in the varying thickness or volume of the high-tension discharge, as well as in the amount of current which the primary of the transformer will draw.

It will be noted that the primary and secondary of the high-frequency coils of the transformer are divided into two sections, and that the middle points of the primary and secondary are joined together and connected to the ground. The separation of the primary and secondary windings into halves is made chiefly for convenience in mechanical construction and to economize space. Connecting the lower terminals of the two sets of windings together and joining the points united to the ground, is done to protect from the high-tension discharge the insulation between the primary and secondary of the 15,000-volt transformer. If the above precaution be not taken and one side of the secondary of the high-frequency transformer be connected to ground, as is often done in certain experiments with the apparatus, one-half of the potential of the secondary of the high-frequency coil is thrown upon the insulation between the two windings of the 15,000-volt transformer.

Suppose the terminal *a* were connected to earth and the ground connection omitted, and the primary circuit of the 15,000-volt transformer is separated from ground by a weak insulation, then the current from the secondary of the high-frequency coil would tend to take the following course: from *a* to ground, from ground to the primary of the 15,000-volt transformer, across the insulation between the primary and secondary of this transformer to the secondary, then through the left-hand winding of the primary of the high-frequency coil to the point *o*, where the primary and secondary of the high-frequency coils are joined, through the left-hand winding of the secondary and back to *a*. Thus if the coil gives twenty inches, the insulation between the primary and the secondary of the 15,000-volt transformer may have to withstand a strain equal to a ten-inch discharge of the high-frequency coil. If the ground connection is made at *o*, it is readily seen that this strain does not come upon the insulation of the transformer.

If the primary of the transformer be made with two windings brought out to terminals 1, 2, 3, 4, the two coils of the primary may be connected in series or in parallel, thus adapting it to a 110 or 55-volt circuit. It is not convenient, however, to construct a variable impedance so as to be equally adapted to different voltages. It is not difficult to construct a high-tension transformer for this work, but it would hardly pay one to make this piece of apparatus, since it can be easily obtained in the market. The spark box, and a convenient manner of constructing it, are illustrated in detail in Fig. 2.

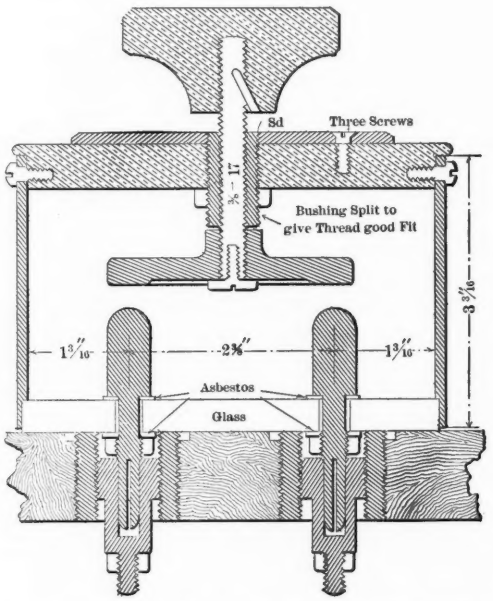


FIG. 2.—CONVENIENT METHOD OF CONSTRUCTING SPARK BOX.

In this form of construction the double air-gap is easily controlled and varied in length by turning the insulated handle, which raises and lowers the circular metal disc; this can be done while the coil is in operation without danger of obtaining a shock. If the discharge-gaps are enclosed in a box, as shown in Fig. 2, the noise of the discharge will be lessened. The coil will be generally found to work better after the terminals of the gap and the air on the inside of the box have become heated from operating the coil.

The condenser is most conveniently made as follows: choose plates of the best quality of window glass, fourteen by ten

inches, and one-eighth of an inch thick. Tin-foil might answer for the metal sheet of the condenser, but a thin brass or metal sheet is much to be preferred because of its greater mechanical strength and the greater ease with which terminals may be soldered to it. The metal sheet when laid on the glass plate should reach to within one inch on the side margins of the sheet, but be kept two inches from the end opposite to which the terminal is fastened. Thus the effective area of two opposing sheets would be eight by ten inches. The condenser should be laid up in the following order: glass, a sheet of heavy paper, brass sheet, another sheet of heavy paper, glass plate, paper, brass, paper, glass, etc. Half of the brass sheets should have their ends projecting a quarter of an inch from one end of the condenser, and the other half of the brass sheets, alternately placed with the first half, should project in a similar manner from the other end of the condenser. The terminals are, of course, soldered to the projecting ends of the sheets, which are bent down to lie flat and slightly overlap at each end of the condenser. To make this condenser so that it will not break down, it should be laid up under oil, care being taken that no air bubbles get in between the plates. The plates may be held in position by means of a wooden frame, and if the condenser be lifted quickly out of the oil in which it was stacked and placed in its permanent box, and the space between the condenser and its box be filled with melted paraffin, a very strong and dry condenser will be obtained, which will not break down with a one-inch discharge across a parallel gap. The capacity of such a condenser, made of forty plates of glass, is about 0.025 microfarad and is very well adapted for the production of very heavy high-frequency discharges. The writers believe that the particular form given to their high-frequency coil is the most efficient that can be built and that it is somewhat novel, and so we will describe its construction with more detail.

Fig. 3 gives in section and elevation the general form of the design adopted. Fig. 4 is a section on the line AB, of one of the halves of the coil, the two halves being identical. V and V_1 of Fig. 3 are two vessels having the relative dimensions indicated in the figure. These vessels may be of glass, hard rubber or compressed paper. The vessels employed by the writers were made of glass. The primary of the high-frequency coil should preferably consist of about four turns of insulated copper strip wound upon each of the two vessels, the two windings being joined together by a flexible connector C. A convenient way of holding the windings in place is to wind them upon a cardboard cylinder which will just fit over the glass cylinder, the copper straps of which the windings are made being fastened to the cardboard cylinders by being sewed to the cardboard with a strong thread. If the copper strap is insulated with tape or ribbon, the turns can come quite close together, if not insulated they must be kept about one-eighth of an inch apart. By adopting the arrangement shown, the highest possible insulation can be secured for the high-tension secondary winding by filling each of the two vessels nearly to the top with thin paraffin oil. The thinner and better the quality of the oil, the better the insulation secured. If the apparatus is located in a place where there is no fear of fire, the highest possible insulation is secured by the use of kerosene oil. The construction of the secondary coil requires considerable care to obtain the highest efficiency and perfectly secure insulation. The dimensions of the secondary should be proportioned about as shown in Fig. 3. The best way to form a framework on which to wind the wire of the secondary coil is to take two circular boards of hard wood which will just fit on the inside of the glass vessels and make in these boards a dozen or more radial slots one-quarter of an inch wide as indicated in Fig. 4. Hard rubber pieces should then be cut out, having the shape shown in Fig. 3, and these be inserted tightly in the radial slots of the two circular boards. By this means a tapered polygon is formed, upon which the secondary winding may be wound. This winding may be made of double silk-covered No. 34 copper wire, the turns should be laid on evenly and close together, great care being exercised that no single turn shall cross over its neighbors. After the winding is completed, it should be ended off with terminals of heavier wire and the whole be given a thick coating of shellac. This must be allowed to become thoroughly dry before the coil is used. A small hole may be drilled in the bottom of each of the glass vessels t and t_1, through which one end of each of the terminals may be passed and then be fastened to the middle point between the two primaries. The holes can be stopped up with cement so the vessels will not leak oil. Heavy terminals mounted in hard rubber can be fastened in circular covers that rest on the tops of the two vessels and make automatic connections with the two terminals of the secondary by means of spring contacts as at S and S_1. One suitable form of construction is plainly shown in Fig. 3. One must be cautioned to make the circular covers of the two vessels of some perfectly insulating material, as hard rubber, otherwise brush discharges and streamers will continually pass up the outside surface of the glass vessels, the discharge attempting to take place between the primary and the terminal in the centre of the cover.

The terminals between which the high-frequency discharge is to pass may consist of balls or points which can be attached to the tops of the permanent terminals passing up through the centres of the covers. As the two halves of the high-frequency coil are independent of each other, being merely joined together by a flexible connector, the halves of the coil can be moved closer together or farther apart, according to the length of discharge which one wishes to obtain.

(To be concluded.)

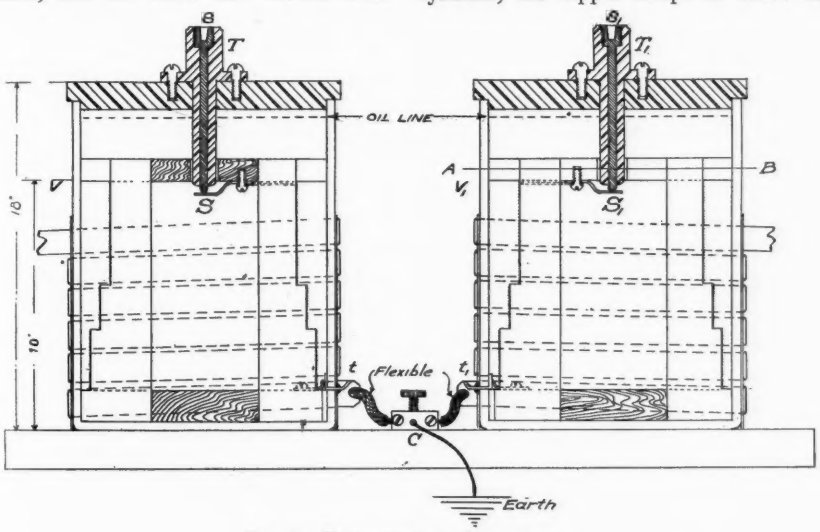


FIG. 3.—ELEVATION OF CONDENSER.

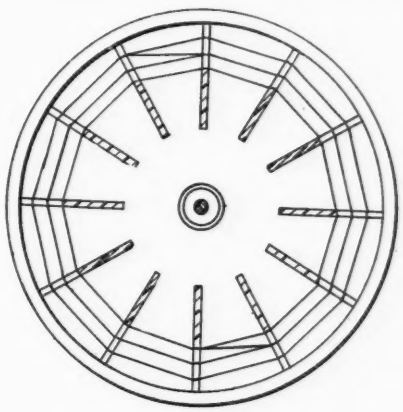


FIG. 4.—SECTION OF CONDENSER.

THE COOPER HEWITT MERCURY VAPOR LAMP.

A LECTURE BEFORE THE PEOPLE'S INSTITUTE AT COOPER UNION, MARCH 1, 1904.

BY P. H. THOMAS.

In seeing the perfected results of great inventions, and in finding how clear and straightforward their principles of operation generally are, we are likely to forget the trials, difficulties and disappointments the inventor must go through before he succeeds in his purpose. Years of perseverance and blind work and implicit faith in ultimate success, together with endless experiments, usually with scant encouragement and little help from others, must be experienced before the invention can be made useful. Furthermore, ultimate success is never certain, though the truly great inventor never admits the possibility of failure. Temporary failures always stimulate such a one to greater efforts.

Mr. Peter Cooper Hewitt is preeminently an inventor by temperament; patient and persevering, supplied with the most original ideas, he has always a new expedient to meet each new difficulty. He has spent eight years and a very great amount of effort in perfecting the mercury vapor electric lamp, which is now available for useful purposes.

In this lamp the light emitted has a most peculiar effect on the color of objects seen by it. The lamp itself looks white with a cast of greenish blue, but most objects have a yellow green look. All of the red tints appear black.

In these lamps there exists no gas, except a very little vapor or gas of mercury. Each atom of mercury in that vapor gives off a small quantity of light when excited by the electric current. Atoms of each different kind of material give off a particular color of their own, that is, different gases give differently colored lights. The color of light you see here is the color given off by the atoms of vapor of mercury, and no other color can be got without adding atoms of some other gas.

When current passes through a vacuum, it is supposed that the stream of very small particles, about one-thousandth part of the smallest atom known, passes from the positive electrode through the tube to the negative electrode. These electric particles travel with enormous velocity, and we can see how the mercury atoms in the tube are excited or set vibrating by being struck by these extremely rapidly moving particles, and so are caused to give light. But when an electric particle strikes a mercury atom, not only will it cause the mercury atom to vibrate and glow, but also the electrical particle is stopped in its course, and must be started all over again, and this takes force. So that the presence of the mercury atoms hinders the passage of the electric particles; that is, introduces "resistance," as it is called. Now, the greater the number of mercury atoms the greater the resistance, so that if there were too many in the tube a very great electric force would be required to cause the electric particles to pass through it. This is the reason for having the air exhausted from the tube. For, if very nearly all the atoms of the gas were not taken out of the tube, a greater electric force would be required to drive the electric particles through than could at all easily or economically be obtained. Furthermore, every time a mercury atom is struck by an electric particle it is heated a little, so that if there were too many atoms present in the tube it would get so hot as to be destroyed. In the lamps as actually constructed there is enough generation of heat from this cause to make the lamps quite warm to the touch. It is then clear why the vacuum is necessary for the operation of the lamp. As a matter of fact, it is necessary to remove something like 99,999 atoms out of every 100,000 that would be present were the tube not exhausted.

If the atoms instead of being mercury were some other gas, the general effect would be the same—each atom of gas would be struck by the electric particles and caused to give light, but, of course, another color would be produced. On the other hand, if there were no atoms of gas whatever present, there would be no light produced, and the electric particles would experience no resistance. Mercury vapor is practically the most suitable material for the lamp.

In addition to the resistance offered to the electrical particles by the mercury atoms, there is another resistance to the current to be considered. The negative electrode at which the electric particles leave the vacuum space seems to act as though it had a skin impervious to these particles, and until an extra high electric force is applied sufficient to force an opening in this skin no current can flow, even though there be an electric force applied amply sufficient to keep the current flowing when once started. Once started the electric particles enter the negative electrode easily, but, strangely, should the current stop only for an instant, the opening in the skin is immediately closed and the resistance reformed, and to start the current another forcible opening must be made, requiring another application of an extra high electric force. No such resistance as this occurs at the other electrode.

All objects give light when they are hot enough. Solid and liquid substances give out white light, a good deal like sunlight, that is, consisting of a mixture of all colors, but gases are peculiar to themselves; they give one particular color, or sometimes two, three, four and even more particular colors, but never very many, whereas sunlight contains thousands and thousands of shades. The result is that when various objects are seen by light from a hot gas they have the opportunity of reflecting only the particular colors existing in the light, if they can not reflect these colors they will appear black or dark. This explains the peculiar effect of the light from mercury vapor. This light contains four or perhaps five colors: orange, yellow, a little light blue, a darker blue, and violet. So mercury light is a mixture of these five colors, and itself looks nearly white, since there are such different colors mixed, but any object which can not reflect some one of these colors can not look other than black in the mercury vapor light.

The Hewitt light is very strong, having something like half the candle-power of a powerful arc light. It has thirty or forty times as much candle-power as an ordinary incandescent lamp. It is considerably more efficient than the arc light, and six or eight times as efficient as the incandescent lamp. That is, it requires one-sixth to one-eighth as much electric energy to give a candle-power as the incandescent lamp.

After this explanation of the operation and characteristics of Mr. Hewitt's light, I will give a brief account of some of the difficulties he met with in its development.

Mr. Hewitt has always been of an inventive turn and before starting his work in electricity had made many ingenious inventions. Some time previous to 1895 he decided to undertake the solution of some greater problem than any he had then attempted, and considered several alternatives. Among these were the problems of getting electricity directly from coal, and the production of useful compounds of nitrogen and oxygen, from the oxygen and nitrogen in the air. These products are very valuable as fertilizers and for other purposes. Also, the devising of some efficient powerful artificial light. He finally selected the latter alternative.

The first step was to select a source of supply for the light, gas, oil, electricity or other source; he chose electricity.

At this time, besides the well-known forms of electric light, the arc and incandescent lamps, there were two methods of obtaining light from electricity; from "Crookes" tubes or from "Geissler" tubes, so-called. The "Crookes" tubes are small glass tubes or globes, exhausted to an extremely high degree of vacuum in which electricity causes certain substances placed within the tube to fluoresce in the dark, that is, to glow with faint colors. "Geissler" tubes are also vacuum tubes, in which, however, a vapor or gas is made to give light. But neither of these tubes gives anything but a very faint glow, and they are entirely inadequate for a source of useful light. As a further difficulty in their use, it must be noted that they can be operated only with very high voltages obtained by means of complicated and inefficient apparatus. This would be a most serious objection, if the feebleness of the light did not render them entirely useless for purposes of illumination.

The fluorescence of the "Crookes" tube was soon found to have no probability of ultimately yielding an efficient light, and Mr. Hewitt turned to the "Geissler" tube.

In his first attempt to improve the "Geissler" tube, Mr. Hewitt found difficulty with electrodes, that is, the pieces of metal where the current enters or leaves the vacuum. These seemed to disintegrate and particles would stick to the glass, so he substituted the liquid metal, mercury, which could easily flow back to the electrode, after being disintegrated or thrown off by the current, and would thus leave the glass unaffected. This was a very great step in advance, and his lamp to-day contains at least one mercury electrode. By this time the "Geissler" tube was so much improved that it would give from one-third to one-half or over candle-power per foot per tube; that is, a tube a yard long gave somewhat more light than a candle. As he continued to work with very powerful induction coils he found that occasionally a very bright flash of light would occur and his choke coils got very hot. This bright flash indicated that he was on the verge of an important advance, and probably was to discover the principle he was seeking.

He next found by combining some of the ordinary direct current, such as is used for incandescent lamps, with the current from his induction coils that he got an enormously increased brilliancy, while, on the other hand, with the ordinary current alone he got no light at all. This experiment contains the great principle of the negative electrode, which has already been explained; that is, the principle that an extra high electric force is required to break down the skin resistance at the negative electrode and allow the current to start, and that once this flow is started it may continue practically without further opposition. The induction coils used to operate the "Geissler" tube gave him this extra high electric force necessary to break down the skin resistance, while the ordinary current which he supplied at the same time, when once started by the induction coil current, continued the flow of electricity and caused the light. Of course, as he found, without the extra high electric force from the induction coils to start the flow of current no light could be produced.

But in spite of these radical advances, which were of the greatest importance, the lamp was still very unsatisfactory. It would start and give a brilliant light for a few moments and would very soon go out, and so on repeatedly. Mr. Hewitt, however, was very much encouraged, and soon discovered that the reason for this going out was the rapid heating up of the lamp. The heating of the liquid mercury caused it to vaporize, and so produced too many atoms of mercury vapor which opposed so much resistance to the passage of the current that the electric force of his supply circuit was not able to overcome it. However, by supplying a large bulb connected with the tube for giving extra cooling surface the lamp's power to keep lighted was very much increased.

Still great difficulties were met and the lamp was not yet serviceable. He found that no two of the lamps were alike, and though some would operate fairly well, others would not. The cooling chamber, though of the greatest importance, did not remove all the trouble. His attention was next turned to the pump by means of which the air and other gases were exhausted from the tube. This he found to be imperfect and unable to remove completely the gases from the tube. You may easily imagine how difficult this was in view of the extremely high degree of exhaustion required for the lamp. His old pumps were not capable of doing the work. Furthermore, air was found to stick to the glass and remain in the mercury and other materials within the tube. The very best pumps that Mr. Hewitt could find were elaborate things with all sorts of complications, and were very unsatisfactory. He experimented with pumps for himself, and finally developed a comparatively simple type which operated very satisfactorily, and which he still uses, and the air which stayed on the glass and in the mercury was found to be driven off by the application of heat and the use of the electric current. Now the lamp was practically complete and its principle thoroughly understood, but there remained still many troublesome details to be perfected; the tubes would not keep their vacuums, and would crack where the wires are taken through the glass, mercury was often found impure, and many other similar difficulties appeared. Patience and perseverance, however, finally overcame all of these difficulties like the immensely greater ones met at the start, and his lamps are now being manufactured for general use.

I have not enumerated all the difficulties which Mr. Hewitt had to overcome in working out his lamps. I have merely chosen some of the most striking to illustrate the great number of discouragements and failures that had to be met before he could obtain success.

Electrical Driving in India.

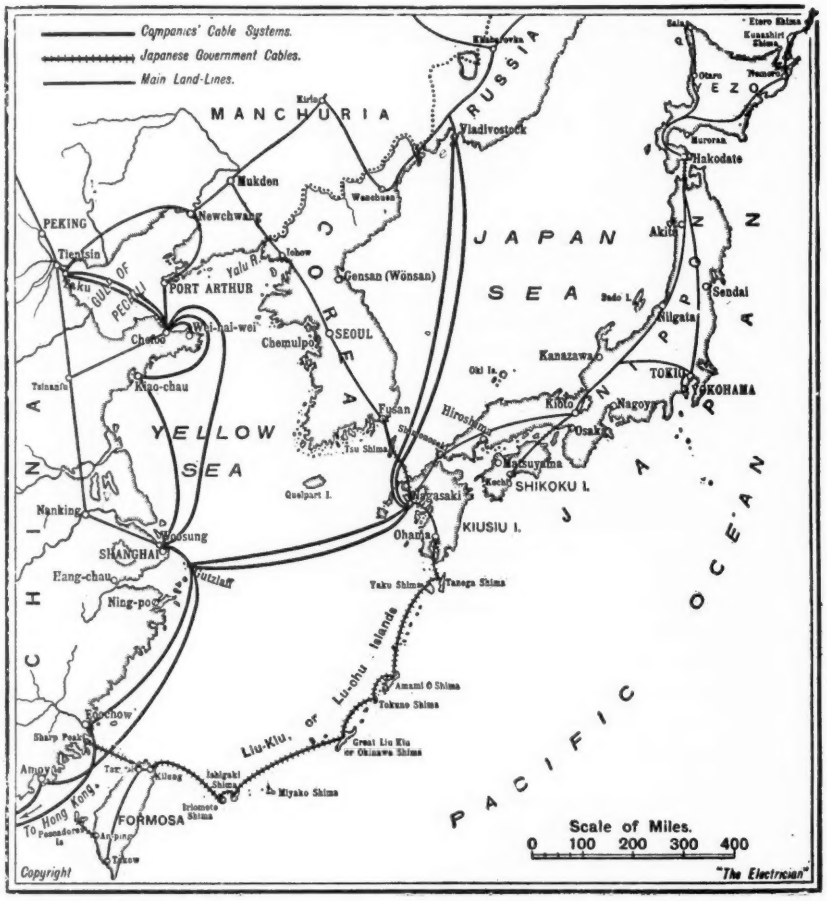
The locomotive shops of the East Indian Railway Company are located at Jamalpore, and are the largest works of the kind in the far east, as well as being one of the largest in the world. In a brief description of this works given by the Indian *Textile Journal,* it is said that some time ago the advantages of the electrical drive were recognized by the officers of the East Indian company, and that, point by point, the old method of driving is being superseded, so that, in a short time, all of the new machine tools will be operated by electric motors. The existing generating station contains three 110-kilowatt 220-volt generators. The shops are fitted with electric lights, and a small electric tram line conveys material throughout the works.

An Experimental Law for the Electrical Transport of Dissolved Salts.

At a recent meeting of the French Academy of Sciences, a note by M. A. Ponsot was presented, which suggests a law for the electrical transport of dissolved salts. In the electrolysis of a mixture of salts of the same acid—only one being electrolyzed—the total number of molecules transported depends only upon the nature and the concentration of that salt; it is independent of the presence and the concentration of salts not electrolyzed. If two salts are electrolyzed, the total number of molecules transported depends upon the nature of these salts, on their concentration, and on the electrochemical equivalent of each. It is independent of the salts that are not electrolyzed, and of the acid.

Cable Communication with Japan.

The London *Electrician* gives the map reproduced below and the following information in regard to the submarine telegraph cables which may be used in transmitting news of the Russo-Japanese War. Russia has complete control of the overland telegraphic routes to the seat of the war on the mainland. Practically all direct news from Korea and the Liao Tung peninsula is transmitted through the cable systems of the Eastern and Eastern Extension companies. The Great Northern Telegraph Company has completed its new overland route by way of Kiakhta to China, which replaces its old Vladivostok route, though, of course, passing through Russian territory.



The main cables through which the greater part of telegraphic news must pass are those completing the Eastern Extension company's route to Shanghai. These are the lines from Hong Kong to Shanghai, one touching Foochow and the other at Amoy and Gutzlaff. There is another cable running from Amoy to Tourane, belonging to the French Government, but this has been interrupted since last November.

From Nagasaki to Vladivostok the Great Northern company has two cables, both of which can be closed to traffic by the Russian Government. Nagasaki is connected by land lines and short cables to all of the important towns in the Japanese islands, including Ohama, from which a cable, owned by the Japanese Government, runs to Formosa, connecting up the small islands en route. This is connected to the mainland by the Japanese Government cable to Tamsin. There is a Japanese Government cable to the island of Tsu Shima, and thence by a Great Northern cable to Fusan, in Korea. It is reported that a Russian cruiser had attempted to cut the island cables. Japan, however, has a cableship and will doubtless be successful in keeping some one of the lines in repair, so that it is not likely that she can be cut off telegraphically.

The Chinese and German government cables go from Woosung to Chefoo, one by way of Kiao Chau, and the other direct. From Chefoo there are two Chinese Government cables to Taku, and one Russian Government cable to Port Arthur. A short cable belonging to the Eastern Extension Telegraph Company connects Chefoo with the British port, Wei-hai-wei. There are also two Chinese land lines connecting Woosung to Chefoo, Tientsin, Taku, Neuchwang and Port Arthur. These connect up to the Korean land lines at Lao Yang, near Mukden. Telegraph lines between Seoul and the main Korean ports are under military control. The same applies to the cable between Port Arthur and Chefoo, which, whether cut or not, has been closed.

BOOK REVIEWS.

"Hyde's Telephone Troubles and How to Find Them." Tenth edition. W. H. Hyde. Milwaukee. W. H. Hyde & Company. Paper. 52 pages. 4¾ by 6¾ inches. Supplied by the ELECTRICAL REVIEW at 25 cents.

This book is designed to be a telephone inspectors' handbook on both the magneto and common battery systems. In the explanatory note the author states that no attempt has been made to write a scientific treatise on the telephone, and the use of all technical words and phrases has been avoided, the endeavor being to present construction troubles and remedies in as plain English as possible.

"Simple experiments in Static Electricity." Percival G. Bull. London. Percival Marshall & Company. Paper. 71 pages. 5 by 7¼ inches. Fully illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This little book forms one of the "Model Engineer" series of handbooks. It is intended for students and amateurs, and was written with the idea of exciting interest, as well as giving instruction in the fascinating field of static electricity, the study of which promises to become most important to the electrical engineer. The book contains several chapters, giving in all sixty-eight experiments, all illustrating methods of electrical excitation and the action of electrically charged bodies. Each one of these illustrations illustrates some effect of electrical forces, but the reviewer thinks the book would have been improved had some instructions for making simple electrical apparatus been included.

"The Electrician Electrical Trades Directory and Handbook for 1904." Published by the *Electrician*, London. Cloth. 6½ by 9½ inches. Two volumes. 1,336 pages and 568 pages. Illustrations, portraits, maps, charts, tables, etc. Supplied by the ELECTRICAL REVIEW at $4.50.

The 1904 edition of the Big Blue Book is a volume aggregating 2,000 octavo pages, closely packed with information and statistics relating to electrical matters. This mass of data covers the large field of industrial work, and is compiled for the most part from official sources, so that it may be relied upon to furnish the fullest information relating to the undertakings which this branch of the industry now comprises. These include electric lighting, electric power, traction, electrical consulting, constructing and manufacturing, land and submarine telegraphy, wireless telegraphy, telephony, electrochemistry, metallurgy and all the many applications of electricity. Particulars are given regarding the finances, as well as the technical side. The book, as has been the cus-

tom for some years, has been divided into two volumes, the first containing a good deal of information of a technical character, and the British regulations regarding the use of electricity. This volume also gives a complete British alphabetical index and a classified index of the electrical industry. Volume ii contains alphabetical indexes for the British colonies, the continents of Europe, Asia and Africa, Central and South America and the United States, together with biographical sketches of prominent engineers and scientists of the world, many of these being accompanied by portraits. These books are invaluable to those firms which have dealings with foreign companies, and in many instances will be useful for local reference.

"Alternating Currents: Their Generation, Distribution and Utilization." George T. Hanchett. New York. John Wiley & Sons. Cloth. 188 pages. 5 by 7½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.

The purpose of this book is to explain to the so-called practical engineers who have not had a scientific training the phenomena, as well as the apparatus, of alternating electric currents. The subject is clearly treated, mathematical demonstrations being almost entirely avoided, and the use of graphical methods being resorted to in the case of the transformer only. To explain the fundamental phenomena of inductance, the author makes use of hydraulic analogy, which is here not only permissible, but of value. The explanation of the action of alternating-current apparatus, instruments, motors, transformers and generators, is clear, and the book is well suited for the purpose for which it is intended.

"Maver's Wireless Telegraphy: Theory and Practice." William Maver, Jr. New York. Maver Publishing Company. Cloth. 216 pages. 6 by 9¼ inches. 123 illustrations. Supplied by the ELECTRICAL REVIEW at $2.

This excellent book, in which Mr. Maver's well-known clearness of description has been exercised at its best, is an important addition to the literature of the subject of wireless telegraphy. The book has, as stated in its preface, "grown up with the art." It is essentially a book for the learner of wireless telegraphy, while at the same time representing in ample space advanced thought and work, as far as these have been published, up to a recent date; that is to say, by placing himself in the spirit of each theory and "system," from the fundamental matters of wave generation and propagation through the latest detailed device for practising the art of space telegraphy, Mr. Maver has given his readers the results, ready at hand, which could otherwise only be obtained by the most exhaustive pursuit of the periodical and other literature of the subject since Hertz. This treatment of the subject has kept out of these pages any spirit of rendering a comparative judgment upon the merits of the various systems; to be informative, with able understanding of the difficulties and questions that arise in the average reader's mind, has been the criterion throughout. If this policy has resulted in the allotment of space to some systems according to the volume of matter that has been published upon them rather than in accordance with their fundamental importance as steps of progress in the art of space telegraphy, such a drawback is a minor one in comparison with the unusual clearness of presentation that has actually been attained, and is perhaps inevitable in a treatise of this kind written at the present stage of the progress of the art. Beginning with a chapter on ancient methods of signaling and on modern "non-Hertzian" wireless telegraph systems, the opening chapters deal with the general nature of wave propagation including Hertzian waves, and involve a presentation of the influence of capacity and inductance without "mathematics;" with theories of electric wave propagation, and with the early academic experiments of Branly, Lodge and Popoff. In chapters vi to xii, after some preliminary explanation of the practical requirements of commercial "tune," the various prominent syntonic systems are dealt with, generally in accordance with their published prominence; the text being aided to a remarkable degree by a series of well selected illustrations. The remainder of the book is devoted to a full discussion of wireless telephony, signaling by ultra-violet rays, the so-called "Armorl" non-Hertzian signaling system, with its capillary electrometer receiver; to special use of space telegraphy in military signaling, etc.; to a discussion of the theories of coherers and other wave detectors with descriptions of the more prominent devices in actual use; and to such subjects as the practical detail of working an installation, arrangement of antennæ, schools of wireless telegraphy, etc., not generally referred to in works of this kind. A very complete index facilitates references, and additional space is devoted, in an appendix, to the quotation of some up-to-date discussion of theories of electric wave propagation, including the views of S. P. Thompson, Taylor, DeForest, Kennelly and others.

ELECTRICITY ANEMOMETRY IN THE SEA COAST ARTILLERY SERVICE.

BY M. C. SULLIVAN.

Electricity is now found in use in the United States coast fortifications in nearly all of the forms and for purposes similar to those for which it is applied in industrial life, as well as for many uses which are purely military in character. In many ways its use has effected results almost revolutionary when compared with the older methods. An instructive example of how it can be made to simplify comparatively elaborate processes is furnished by the use made of it in determining wind velocities. Data for much of the following has been taken from War Department publications. The determination of the amount of wind pressure to which structures are liable is of great importance to architects and engineers, but to the artillerist it is the most important of the variable atmospheric elements which affect the flight of projectiles. The pressure exerted by the wind against an obstacle in its path depends upon its velocity and of the size and shape of the surface against which the pressure is exerted.

The instrumental methods by which wind velocities are determined may be divided into two classes, *viz.*, pressure anemometers; rotation anemometers.

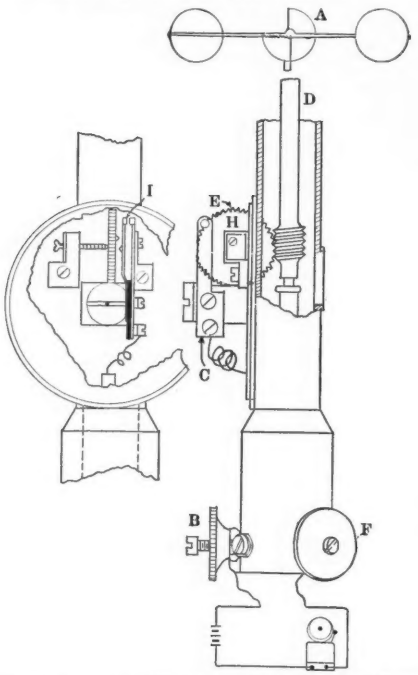
Pressure anemometers belong to the class of instruments in which the pressure exerted by the wind in overcoming a force whose power is known is taken as the basis of measurement.

The rotation anemometer is an instrument depending for its action upon the propelling power of the wind, setting in motion a system susceptible of rotation about an axis, the velocity of its rotation being taken as the basis of measurement.

Pressure anemometers, as compared with rotating anemometers, register momentary gusts, thereby furnishing data for obtaining maximum velocities and pressures, while the rotating anemometers are essentially machines for giving total movements and average velocities for definite intervals of time. For artillery purposes the rotation anemometer gives the best results because a knowledge of the velocity of the wind is of greater value than any observed pressure, for, knowing the velocity, the pressure upon any special projectile under consideration can be determined by such formula as experiment and practice may indicate to be appropriate for it.

In Figs. 1 and 2 are shown the electric

anemometer used in the Sea Coast Artillery Service. It consists of four hollow hemispheres or cups fixed to the ends of two horizontal rods A crossing each other at right angles and supported on a ver-



FIGS. 1 AND 2.—ELECTRIC ANEMOMETER USED IN SEA COAST ARTILLERY SERVICE.

tical shaft D whose worm thread is geared into the wheel H. On the face of wheel H are beveled projecting pins E which engage with a beveled projection on the spring I. The pins are so arranged on wheel H as to momentarily close circuit through a single stroke bell for every twenty-five revolutions of the cup arms A. The electric circuit starts at the insulated binding-post B, goes through wire to the insulated spring C, where it is completed to spring I to frame of instrument and the uninsulated binding-post F. From binding-posts B and F, where start the line wires, the circuit is completed through bell and battery.

The observer may be (and usually is) a considerable distance from the rotating part of the system taking the velocities at the place where they are wanted. The bell being located in the "fire commander's station," the rotator being at some elevated point in the vicinity.

In standardizing the various forms of anemometers it was originally assumed that the centres of the cups move only one-third as fast as the wind. This relation has been known to be more or less inaccurate.

As a result of experiments made by the professional assistants of the Signal Corps, United States Army, the accompanying chart is arranged after the equation determined by Professor C. F. Marvin to express the relation between the motion of the cups and the wind velocity for the service anemometers having four-inch hemispherical cups on arms 6.72 inches long.

It gives actual velocities from five to fifty miles per hour and the corresponding indicated velocities. To obtain velocities an ordinary stop-watch reading to 0.2 second is used. With the watch hand at zero it is started at a stroke of the bell and stopped at the next stroke.

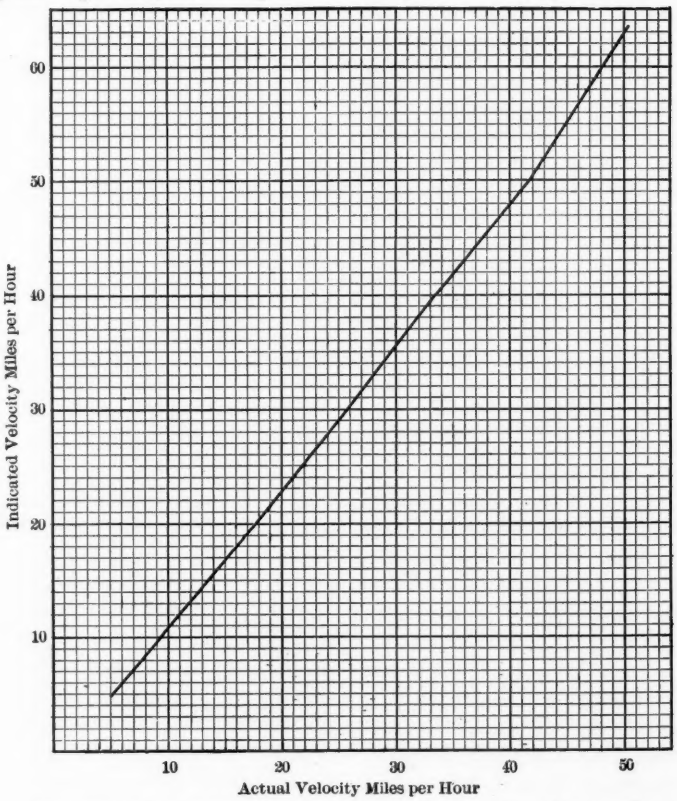
The actual velocity in miles per hour corresponding to readings of watch is read directly from the following table, velocities between the figures given being estimated.

TABLE OF VELOCITIES FOR STOP-WATCH OBSERVATIONS.

Actual Velocity Miles per Hour.	Time in Seconds between Strokes of Bell.
50	2.85
45	3.21
40	3.64
35	4.5
30	5.0
25	6.1
20	7.8
15	10.9
10	17.5
5	36.7

The table is determined by computing the time required for the wind to travel 0.05 of a mile corresponding with twenty-five revolutions of the cups during which the circuit is closed once. This indicated velocity is then corrected by the chart of corrected velocities and the actual velocity corresponding to the indicated time is placed in the table as the proper velocity. In using the stop-watch, the first press of the stem starts it, the second press stops it, giving the indication, and the third press sets it back to zero.

It will be seen that to ascertain the velocity of the wind at any moment all that is necessary is to press the button, read the watch and table.



CORRECTED RELATION OF INDICATED AND ACTUAL WIND VELOCITIES.

A New Alloy.

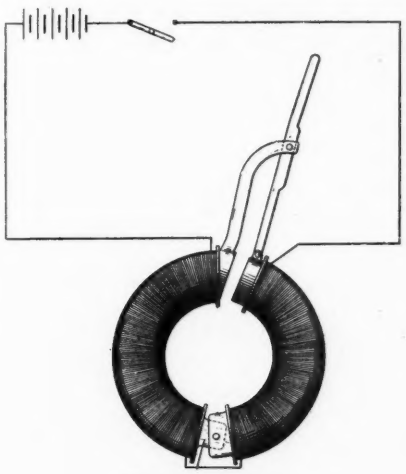
U. S. Consul Richard Guenther, at Frankfort, Germany, reports that Dr. Guillaume, a physicist of Frankfort, has found that alloys of nickel and steel may be made which have a negative temperature coefficient of expansion. By obtaining suitable proportions of the two metals the coefficient may be reduced to zero, and it is thought that this material will be of considerable importance in the construction of scientific instruments, particularly measuring instruments for hot climates. It may also be found useful in chronometers, a pendulum made of this material requiring no equalizing attachments.

The Technical World.

The first issue of the *Technical World*, a monthly periodical published by the American School of Correspondence, of Armour Institute of Technology, Chicago, Ill., has come to hand. This contains sixty-eight pages of interesting matter, covering various fields of science and application. The first article is a popular study of radium, by Dr. Robert A. Milliken. Then follows an article on the milling machine, by E. R. Markham, and a simple explanation of wireless telegraphy is given by Dr. W. E. Deeks. There are also a number of short contributions on various branches of engineering.

Electrical Patents.

James C. Keller and Otto F. Kadow, of Cleveland, Ohio, are the inventors of an electromagnet, the purpose of which is to make the core of an electromagnet in such a shape and in such a manner that it will serve as a mechanical element to perform functions usually performed by outside mechanisms, and to that end the core of the magnet is made of a plurality of members, each separately wound and one of which is movable, so that when the core is energized by the passing of an electrical current through the surrounding conducting wire, the magnetic field surrounding the energized core is such that the movable member of the core will be attracted and moved toward the other member or members and will operate other mechanical elements connected with it. In the present electro-

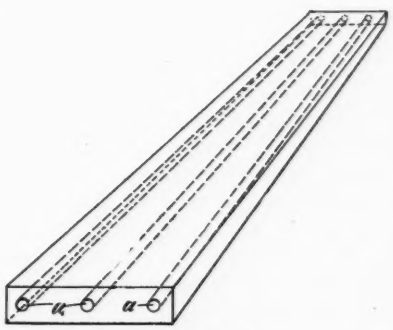


ELECTROMAGNET.

magnet, a core is provided consisting of two members made of soft iron or other suitable metal and connected at their ends by a hinge. Coils of conducting wires are wound around the member of the core, and lead to and from a battery or other suitable source of electrical energy. The circuit is provided at any suitable point with a switch, whereby it can be opened and closed at will. One member of the core is fixed in suitable supports and is provided with an upwardly extending bracket. The hinged movable member is provided with an upwardly extending rod hinged thereto, and adapted to oscillate on the bracket. The ends of the two members are each within the magnetic field when the core is energized. It will therefore be seen that if a current of electricity be caused to be passed through the conductors by closing the switch the members will be attracted toward each other, causing the rod to move from left to right at its upper extremity.

A process of preparing electrodes for storage battery cells has been invented by Oskar Frank, of Detroit, Mich., who has assigned the patent obtained thereon to Levi J. Lennox and the Michigan Storage Battery Company, of the same place. As an electric accumulating battery is efficient only when the lead grids have become porous to a certain extent, Mr. Frank proposes to subject the electrodes to the following treatment: he first forms an electrolyte by mixing with ninety-five per cent of H_2O five per cent of Na_2SO_4 and 0.7 per cent of $HClO_4$. In this electrolyte the grid-form plates or electrodes are placed, preferably, parallel to each other in any desired number. Generally eleven plates are placed in one receptacle standing parallel, those facing one way, usually five, are positive plates, and the six others, alternating with these, facing the other way, the negative plates. A current of one ampere is sent through this series of plates, with temperature at about twenty degrees centigrade. Through this treatment the positive plates are covered with chlorine, which can be noticed by the white coat with which the plates are covered. This process is continued for the full length of time, at the end of which time the positive plates will have been penetrated to the depth of one millimetre. The plates are then removed from the electrolyte and thoroughly washed in distilled water. They are then put into a weak solution of $H_2SO_4 + H_2O$. This removes the chlorine, and in order to remove all the chlorine the positive are used as negative plates and sheets of lead are substituted for the positive plates and connected up as before, and then charged with a current of two amperes, then the capacity-increasing element peroxide appears. After the plates have been subjected to this treatment, they are taken out of the last mixture and all the HCl removed by thoroughly washing in distilled water and dried in air with temperature at about 300 degrees centigrade, preferably the air current from the kettle in which the metal for the plates is being melted. This gives the plates a solid coating of lead superoxide. The plate is then taken for a positive-pole plate, and after the active material has been introduced into the plate, and together with the negative-pole plate goes to make up a cell.

A dynamo brush has been invented by Max Bunnig, of Gardelegen, Germany, which relates to the manufacture of dynamo brushes consisting of metallic dust in combination with a suitable binding means. The invention consists in the employment of a special binding means for the metallic dust, namely, tar. At the heating of the brush the tar will not become carbonized, but coked, so that in this state it will leave in the brush only a very small residuum of ashes, but about one-third of its weight, partly as fine distributed carbon and partly as coke. The residua have become conducting by the heating process, so that they will not injure the conductibility of the brushes. The residuum of ashes which remains in the brush at the employment of tar amounts only to about 0.04 per cent, and the action of it will be compensated by the conducting material being conveyed in to the brush in the form of coked tar. On the other hand, the stability of the brush becomes duly increased by reason of the want of residua of ashes. Thus the breaking of the ashes will be reduced to such a degree that it may happen only in consequence of inattention, while the crumbling off of the brushes is fully dispensed with, so that a smooth and even contact face will be permanently obtained, which



DYNAMO BRUSH.

leans close to the collector. The process of manufacturing is as follows: the metallic dust is first mixed with a corresponding quantity of tar until a granular mass is obtained which will be pressed by means of folding machines into the brush shape as desired. Simultaneously with the pressing of the brush longitudinal channels are formed with the body of the brush. This body will then be heated until it has reached a temperature at which the tar will be coked. After the cooling, a mass being a little softer and consisting advantageously of a mixture of graphite and metallic dust will be injected in the channels, whereupon the body will be heated once more to about one-third of the former temperature. The arrangement of the channels within the brush and the stuffing of these with a softer mass make it possible for it to reduce respectively, to soften the hard friction of the brush upon the collector, and to effect in a certain manner an automatic lubrication.

Reviews of Current Engineering and Scientific Literature.

Electrical Manufacture of Nitrates.

After referring briefly to the electrical processes for fixation of nitrogen which have already been described, M. Albert Modon gives some particulars of the new process due to MM. Howalski and Moscicki. This process consists in setting up oscillatory charges between aluminum rods arranged radially about a central axis and opposed to similar aluminum electrodes passing through, but insulated from, the enclosing-vessel. The distance between the electrodes is twenty centimetres, and the pressure is 50,000 volts. Electrical energy is furnished by an oil-insulated transformer at a low frequency. In the supply circuit a group of reactance coils and condensers, the latter formed by silver-plating glass tubes, is connected. The current taken is about 0.05 ampere. The output is said to be about fifty-three grammes of nitric acid per kilowatt-hour, but this can be doubled by adding oxygen to the air to the amount of fifty per cent. This use of oxygen increases the cost of the process somewhat, as to produce one kilogramme of nitric acid, 500 litres of oxygen are required. It is thought that preparing this oxygen electrolytically will require eight kilowatt-hours, but it can be prepared by a liquid-air process, at a cost of one kilowatt-hour. To prepare one kilogramme of nitric acid would then require ten kilowatt-hours. If the voltage be raised to 150,000 or 200,000, a considerable increase in the efficiency may be effected. This may be accomplished by using influence machines, and it is said by M. C. Brandt that thirteen such machines, requiring one kilowatt to drive them, will produce from fifty to fifty-eight grammes of nitric acid per hour. These machines, if enclosed, can be operated under all conditions of weather. Assuming the cost of hydraulic power to be one-fifth cent per kilowatt-hour, the cost for 100 kilogrammes of nitric acid made by the Howalski and Moscicki process would be $1.90. At Niagara Falls the price of power is considerably less, so that the cost per 100 kilogrammes of acid would not be more than ninety-five cents or $1.20. If nitrates can be prepared at this rate, the effect on agriculture will be considerable, as the present selling price of nitric acid is about $5.25 per 100 kilogrammes.—*Translated and abstracted from L'Électricien (Paris), February 27.*

Cost of Street Lighting.

According to Mr. W. H. Storey, the difficulty experienced in this country in determining the cost of municipal lighting is also met with in England. A good illustration is that furnished by Westminster, where several companies have contracted for lighting the city by gas and electricity. One of these companies has entered into a contract whereby it will supply 1,000 arc lamps and a smaller number of incandescent lamps for thirty years. The price to be paid is $155.50 per year for a 750-watt arc lamp; $106.92 per year for a 500-watt arc lamp; $19.50 for a 120-watt incandescent lamp, and $14.58 for a sixty-watt lamp. These prices are to be subject to a cumulative rebate of one-half per cent per annum for each year after the first. These rates are compared with those at Edinburgh, where the original rate for an arc lamp was $106 per year, but which has been reduced about thirty-three per cent. Westminster has also entered into contracts with the Charing Cross company and the St. James & Pall Mall company, at the rates of $136 and $145.80, respectively. These contracts do not run as long a time as the first one mentioned. The city surveyor has secured a portable photometer and has taken a large number of readings, with a view to determining the relative cost of city lighting per candle-power-hour. The results show that when account is taken of the light produced, the electric arc is twice as cheap as the Welsbach mantle, if the prices at which lighting is done at Westminster may be taken as characteristic estimates of the rates at which lighting can be undertaken profitably. The price of coal does not figure largely in these results. This photometer has also shown that there is a wide variation in the light supplied by the different types of Welsbach burners in use in Westminster. In some cases the cost per candle-power is twice as great as that for others. Suggs high-pressure incandescent mantles show results nearly as good as the electric arc, but these results are obtained only when the mantles are in good condition and the regulating apparatus in perfect order. These lamps are used only in large units, and thus present no advantage in this respect over the arc lamp. The real advantage of the Welsbach mantle lies in the fact that it is economical, even though used in small units, and it is thought that this indicates that there is a large field of usefulness for the Nernst lamp if it can be applied to street lighting without any ground glass bulb.—*Abstracted from the Electrical Magazine (London), February.*

Cascade Mounting of Motors for Plate Rolls.

A system of operating induction motors used for driving plate rolls at the Sandviken (Sweden) forges was described recently by M. E. Danielson in a German periodical, from which these notes are taken. The forges of Sandviken form one of the principal Swedish establishments, and have been driven up to the present time entirely by steam. Now the electrical drive has been adopted in the form of three-phase currents at 20,000 volts, fifty cycles, generated at a waterfall fifty-four kilometres distant. This fall is situated at Näs, and has an output of 2,000 horse-power. The greater number of the motors used in the works are of the ordinary constant-speed induction type, with the exception of the motor driving the roll, which operates without rheostatic loss at 428, 375 and 333 revolutions per minute. This motor consists of two induction motors mounted upon the same shaft. The main motor has four poles and the second can operate either as a four-pole or two-pole machine. For the highest velocity the primary motor operates alone, the secondary receiving no current. For the mean angular speed the auxiliary motor operates as a bipolar machine coupled in cascade with the principal motor. The lowest speed is attained by coupling in the same manner the auxiliary motor, operating as a four-pole machine. The power in all cases is 110 kilowatts, and the following efficiency and power-factors are obtained: at 333 revolutions the efficiency is eighty-seven per cent and the power-factor 0.81; at the mean speed (375 revolutions per minute) the efficiency is eighty-eight per cent and the power-factor is 0.83; and with the maximum speed (428 revolutions per minute) the efficiency is eighty-nine per cent and the power-factor 0.92. By adding two switches to this equipment it is possible to obtain two higher speeds. Thus, by

reversing the auxiliary motor and connecting it in cascade, a speed of 500 revolutions per minute is obtained. By connecting the auxiliary motor to the power circuit, thus converting it into a frequency changer, and connecting the principal motor to the rotor of the other, a speed of 600 revolutions per minute is obtained, without the use of rheostats.—*Translated and abstracted from L'Industrie Electrique (Paris), February 25.*

Electrical Power in British Shipyards.

An interesting discussion is here given by Mr. C. S. V. Brown of the adaptation of the electric drive to the British shipyards, special reference being made to those on the northeast coast. In 1894 there was not an electric motor at work in any of the shipyards in this district for the purpose of driving the tools used in shipbuilding. There were possibly a few motors used for cranes, and a few dynamos for lighting. In 1904, with very few exceptions, there is not a single shipyard which does not drive either the whole or a very considerable portion of its machinery electrically. The economies effected by this change have been very considerable, but it is difficult to give exact figures, since there has been a considerable change both in the amount of work and the kind of work done. It is said, however, that the price paid for labor in one instance has doubled during this period, without any increase in the cost of power. In one yard the average size of the ships turned out ten years ago was 316 feet in length and forty feet beam. Two years ago it had gone up to 475 feet in length and fifty-six feet beam. In constructing these larger vessels the flexible electrical drive has been an important factor. Another important factor in reducing the cost of power is that of concentrating all power machinery in one generating station located at the water side, and using a cheap grade of coal. Due to this concentration, it is found that rarely more than sixty-six per cent of the nominal horse-power of the motors installed is called for. The types of plant used are 125 volts continuous current, 220 volts direct current, and 440 volts three-phase current. In the direct-current plants shunt dynamos are used. These supply both lights and power. An interesting instance is mentioned where a boiler plant supplied power to winches and to an engine driving tools in a near-by shop. It frequently happened that when the winches were used, this engine could not secure enough steam to drive it. Electric motors were placed on top of the winches, and were supplied with power from a dynamo belted to the engine. With this arrangement it was possible to close down one of the boilers and operate all the winches and all of the machines from the engine. Another development which has been brought about by the use of electricity is the extension in the work done at the shipyards. Yards which formerly turned out merely a hull now build vessels complete except for the main driving engines and boilers, the hoisting apparatus and the steering gear. These yards equip vessels electrically and, in many cases, build their own electrical machinery. This latter work has grown out of the electrical repair shops established to take care of the motors.—*Abstracted from Cassier's Magazine (New York), March.*

A 20,000-Volt Transmission Plant.

An interesting European transmission plant, built for the Vereinigte Elektricitäts Actien Gesellschaft, of Vienna, is here described by Mr. A. J. Bloemendal. The prime motive power is supplied by one of the numerous branches of the Mur, one of the largest rivers of Styria. The head-race is 1,400 yards long, excavated in rock. The head works are placed at the point where a mass of rock forms a strong natural dam wall, effectually diverting drift ice. The power-house is 820 feet long and seventy-two feet wide. The difference in level between the head-race and the tail-race is eighteen feet. The generators are direct-connected to the turbines, although this brings them down below high-water level. The turbines are governed by oil pressure, controlled by a small governing motor. Each generator is rated at 500 kilowatts, and they are of the revolving pole type. The commercial efficiency is 94.5 per cent, that of the turbines being 76.5 per cent. The voltage regulation is eight per cent, with a power-factor of unity, and sixteen per cent with a power-factor of 0.8. Switches of the Hörner type were adopted, rather than oil-break switches, for the sake of simplicity and ease of inspection. The rheostats for the machines are arranged so that they may be coupled together and operated as a unit. Ground detectors are inserted on both primary and secondary circuits. Single-phase transformers, connected in delta, have been adopted. These raise the voltage from 1,500 to 21,000. The high-voltage conductors are bare copper wires. They pass out of the power-house through glass tubing. The safety cutouts are of the Westinghouse aluminum-wire type. Lightning arresters have been installed, but are provided with switches enabling them to be cut out of the circuit. All insulators were tested at 120,000 volts. They are supported on wooden pins impregnated with paraffin. The wires are mounted in a triangle one metre apart. Every pole is fitted with a lightning rod, and about every 1,000 yards there are lightning arresters with magnetic blowouts. When the line was first put into service it was tested by gradually raising the voltage up to 24,000. During this test one section bore 18,000 volts for an indefinite period, but on an increase of only fifty volts an insulator broke down, short-circuiting the line. The length of the line is twenty miles. Where it crosses the Mur river it is suspended from steel ropes, and in crossing railways and other circuits it is laid on light lattice bridges. The factor of safety in all cases was six. Over road crossings protective nets, suitably earthed, have been put up. Since the day of starting, the plant has been operating without any hitch, even during the severest weather.—*Abstracted from Engineering (London), February 26.*

Electricity in Japan.

According to the London *Electrical Engineer,* there is a great activity in the utilization of electricity in Japan, for lighting, power and traction purposes. The electric light works at Tokio have been in operation for a considerable time, with much success. The output at present is 5,000 horse-power, but this is being increased by an additional 3,600 horse-power. One city of Japan plans to develop 10,000 horse-power by using the power of the Tama river. Power stations will be erected at three points. Electric traction systems are being installed at various points, one of these, twenty miles in length, now being built. The power plant for this road is in course of erection, and will have an output of 540 horse-power.

"Minor Wireless Telegraph Progress."

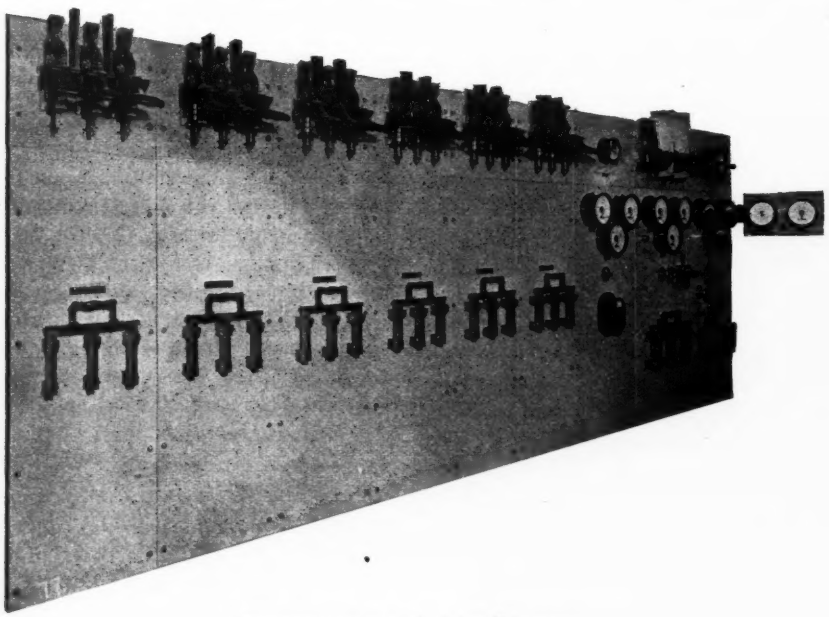
In the article published in the issue of the ELECTRICAL REVIEW for March 12, on the subject of "Minor Wireless Telegraph Progress," by Mr. Joseph B. Baker, and under the subheading "Wireless Telephony," reference was made to the speaking arc, assigning its invention to Mr. Hayes, of the American Bell laboratory. This credit should have been given to "Hayes and Cram."—ED.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Switchboard for Sugar Refinery.

The accompanying illustration shows a new switchboard which has been built by the Walker Electric Company, 2318 Noble street, Philadelphia, Pa., for the Glucose Sugar Refining Company, Chicago, Ill. This switchboard is composed of two-inch blue Vermont marble, arranged in eight



SWITCHBOARD FOR GLUCOSE REFINERY.

panels, reading from right to left as follows: one exciter panel, one 2,000-ampere generator panel, one total load panel and five feeder panels.

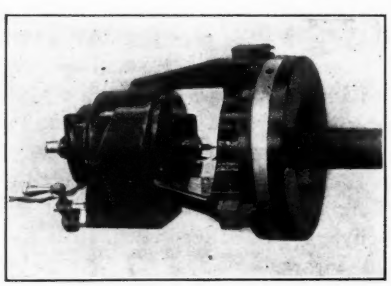
The whole switchboard is securely bolted to the floor and wall by insulated braces, and controls three-phase, 440-volt, sixty-cycle, 7,200-alternation, alternating-current machinery used in the production of sugar in the glucose works. Mr. C. A. Chapman, of Chicago, Ill., was consulting engineer for this plant.

A Portable Centering Device.

The accompanying illustration shows a light portable device for centering shafting, rounds, hexagons, etc., which has recently been designed. The machine consists of a universal chuck fitted to a frame. This frame is, in the present instance, composed of aluminum compound, and holds in its opposite end a motor with a drill and countersink aligned with the centre of the chuck. The motor travels in a gib slide, and is operated by a feed screw and handle, causing the drill and countersink to enter the end of the bars. Wear and play are taken up by means of slides and set screws at the base of the casting. A stop across the inside of the chuck prevents the drill point from being brought into too sudden contact with the end of the bar through careless handling.

These machines should have a wide application in general work, as they obviate the necessity of carrying a heavy bar to a centering machine, and make it unnecessary to centre the bar in the old-fashioned way with a lathe. The device can be carried to the bar, wherever it may be lying, and the centre found very quickly.

The motive power may be obtained from any electric light fixture of 110 volts direct-current, or it can be operated by



PORTABLE CENTERING DEVICE.

a small storage battery. The power is controlled by a switch on the rear of the motor.

This machine may be made in different sizes for large or small work. In the present illustration the machine shown is ten inches in length. The outside diameter of the chuck is eight inches, and the total weight is about twenty-five pounds. This will centre bars from 0 to 4 inches. The work is done accurately and speedily.

The inventor claims a decided advantage in that cropped or rough ends do not need to be cut square before centering. Enquiries may be addressed to Frank H. Hudson, 110 State street, Boston, Mass.

The Fostoria Tipless Lamp.

The Fostoria Incandescent Lamp Company, Fostoria, Ohio, is placing on the market a tipless lamp, an illustration of which is shown herewith. The Fostoria company states that it has overcome what may be termed the inherent defects of the older forms of tipless lamps. These were cracked seals, loose bases, poor vacuum and short life, due to defects from the sealing-in and exhausting processes. Not only does the company claim the elimination of these defects, but it also holds that this lamp is an actual improvement over the tip variety.

The elimination of the tip on an incandescent lamp bulb brings about a number

FOSTORIA TIPLESS INCANDESCENT LAMP.

of improvements. There is less liability of breakage, due to the sharp point coming in contact with the work in factories; and for general illuminating purposes—in a vertical direction particularly—the elimination of the tip is very much to be desired.

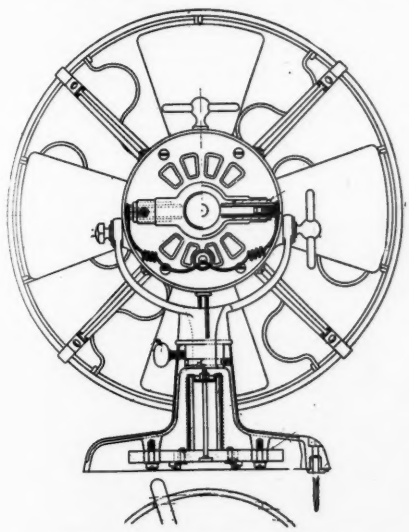
A Long Single-Span Bridge Over the Miami River.

The Brackett Bridge Company, Cincinnati, Ohio, was the successful bidder on the new bridge to cross the Miami river at Elizabethtown, Ohio. This is a single-span bridge 586 feet long from centre to centre of end pins. It is one of the longest single-span truss bridges ever contracted for. Mr. H. G. Tyrrell, 518 Walnut street, Cincinnati, Ohio, is the chief engineer.

Westinghouse Electric and Manufacturing Company's Fans for 1904.

The general appearance of the 1904 fan motors for direct current will be the same as that of last year.

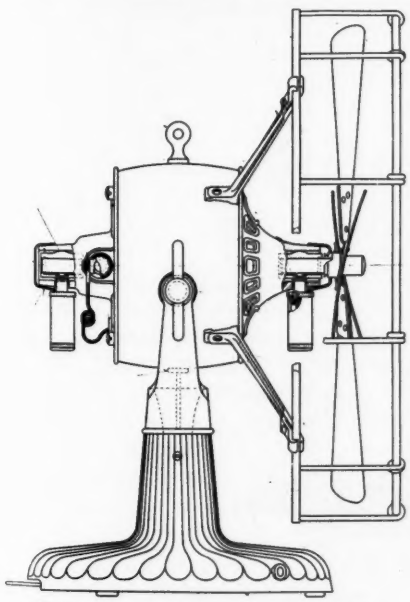
The motors will have a new brush-



WESTINGHOUSE DIRECT-CURRENT FAN.

holder made of brass. The armature leads are clamped to the outside end of the holder by a plug screw, which facilitates repairing without breaking these leads.

The motor will have a new design of bearing made from regular bearing metal, which reduces friction to a minimum. The construction of the bearing

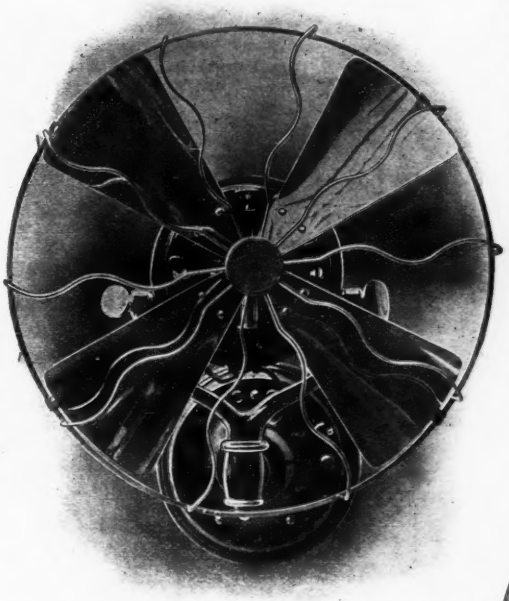


WESTINGHOUSE DIRECT-CURRENT FAN.

is such that the seat is a ball, rendering the bearing perfectly self-aligning. This bearing is short and is arranged to distribute oil easily, making the bearing as nearly as possible self-oiling.

Over the ends of the bearing housing a cap is placed to prevent oil from being thrown off or dripping outside the motor. This cap has a groove in it which returns any oil that does get as far as the cap back to the oil well.

A new base has been provided, so constructed as to enable the resistance needed for slow speeds to be placed inside of it. This resistance is therefore removed from the motor, hence it has no injurious heating effect on the winding of the motor proper. This resistance, together with a switch, are both mounted on a porcelain slab inside of the base of the motor, which enables the operator to obtain three speeds of approximately 1,500, 1,250 and



WESTINGHOUSE ALTERNATING-CURRENT FAN.

800 revolutions per minute at will by throwing the switch.

The motor proper is suspended by means of a swivel and trunnion, which allows the fan to be placed at any horizontal or vertical angle. The motor is supported in the trunnion by means of a pin and set screw. Only one set screw is used so that only one hand has to be used for clamping, while the other hand is free to adjust the position of the motor.

The supports for the fan guards are made from malleable iron, which provides a very stiff support and prevents any possibility of the guard getting against the fan blades. This eliminates the possibility of having the motor take more power than it normally does.

All these motors will be finished in black enamel with polished brass parts, such as brush-holders, caps, etc.

The alternating-current fan motor will have but slight change from last year. The bearings are so constructed as to enable a small strip of felt, soaked in oil, to lie along the bottom of the shaft and to be fed with oil from the oil well. This arrangement keeps the whole bearing well oiled. A cap is placed over the end of the bearing, as on the direct-current motor, and any oil that gets as far as the hub of the fan is wiped off and returned to the oil well.

General Incandescent Arc Light Company's Fans for 1904.

The "Paragon" fan motors, built by the General Incandescent Arc Light Company, New York, remain fundamentally unchanged, the machines have been improved in minor details, but the general design is the same.

The field-magnet is a single-piece casting of soft iron, with the front journal box integral, the rear bearing is contained in a removable cap, as indicated by Fig. 1, the removal of which leaves an aperture large enough to withdraw the armature and field coils.

The field-magnet coils are machine-wound, covered with two layers of linen tape, dipped in insulating varnish and thoroughly baked. The

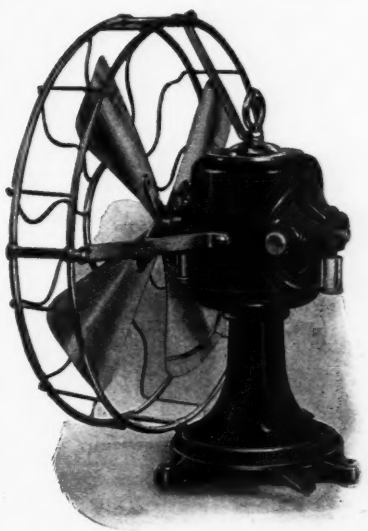


FIG. 1.—"PARAGON" FAN MOTOR.

armature is of the slotted drum type, hand-wound, the complete armature is dipped and baked.

As shown in Fig. 1, the brush-holders are mounted in the removable journal cap, the brushes are rectangular carbons fed by helical springs in the usual manner. The bearings are self-aligning, have phosphor-bronze sleeves, and are lubri-

cated by under-feed wick oilers in the standard machine. The company also builds what is known as the "Paragon Black" fan motor, which differs from the standard machine only in point of finish and in the use of grease instead of oil cups for lubrication. The standard motor is finished in plain black enamel, with dipped and lacquered brass work and an enameled iron fan guard instead of the polished brass guard used on the standard "Paragon" motor.

Fig. 2 illustrates the "Paragon" swivel and trunnion form of mounting, from which it will be seen that the trunnion adjustment is limited by a stud projecting through a slot in the trunnion arm and the motor is held in position by a thumb nut on this stud. The machines are also built with bracket form of mounting. All of them are built with twelve-inch and sixteen-inch fans and wound for the usual direct-current voltages up to 250 volts.

FIG. 2.—"PARAGON" SWIVEL-FRAME FAN.

They are provided with enamel insulated resistances and regulating switches which give three running speeds, the resistance being mounted within the pedestal. The twelve-inch machines run at 1,700 revolutions per minute, and require from thirty-five to forty-five watts, according to the voltage. The sixteen-inch fan motors run at 1,500 revolutions per minute and require from sixty to seventy watts, according to voltage. These data apply to both the standard and the "Black Paragon" fans.

The Diehl Manufacturing Company's Fans for 1904.

In external appearance the 1904 fans of the Diehl Manufacturing Company, of Elizabethport, N. J., will not differ from the line which has been well known for some time. Improvements have been made chiefly in the direction of insulation and in perfecting the mechanical and electrical efficiency of the fan motors. The accompanying illustrations show in Fig. 1 the No. 12 standard Diehl ceiling fan of the external ring armature type, and in Fig. 2, the No. 45 ceiling fan of the drum armature type.

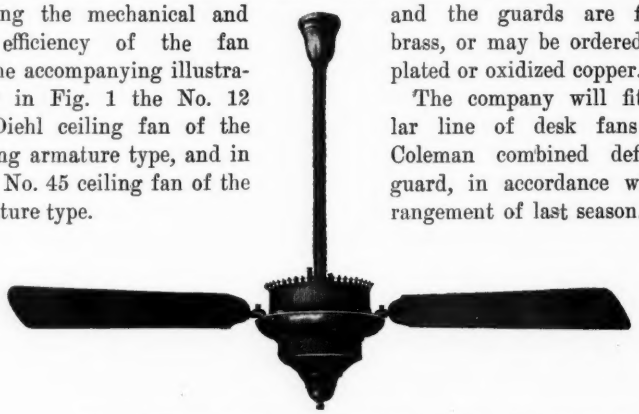


FIG. 1.—DIEHL CEILING FAN, EXTERNAL RING ARMATURE TYPE.

For 1904 the Diehl company will offer an attractive addition to its standard line. This will be in the form of a universal swivel trunnion propeller fan. Fig. 3 shows this fan used as a bracket fan. The manipulation of the fan to convert it from a bracket to a desk fan, or *vice versa*, is extremely simple. The ball joint is secured by a screw which penetrates through the casing and engages with a split ball inside. The removal of this screw allows the joint to be turned through the proper angle, and upon inserting the screw, and bringing it up tight, the joint is locked in the desired position. This fan will be made in twelve-inch size for any voltage up to 220, and in sixteen-inch size for any voltage up to 500 volts, direct current. Cartridge type brushes will be used, but instead of these being in pencil form, they will be of rectangular cross-section. Wick-feed oiling arrangements will be provided. The bases of these fans are finished in black japan, and the guards are finished in brass, or may be ordered in nickel-plated or oxidized copper.

The company will fit its regular line of desk fans with the Coleman combined deflector and guard, in accordance with its arrangement of last season.

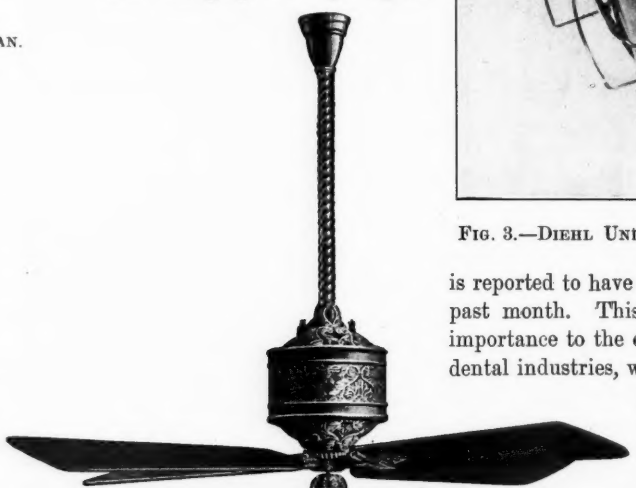


FIG. 2.—DIEHL CEILING FAN, DRUM ARMATURE TYPE.

Iridium.

A marked increase in the price of iridium, the second in commercial importance of the platinum group of metals, is reported to have taken effect during the past month. This fact is of particular importance to the electrical, chemical and dental industries, which are extensive consumers of the various alloys of iridium and platinum. Recent reports indicate a very marked shortage in the supply of iridium, while the demand for this metal is rapidly increasing.

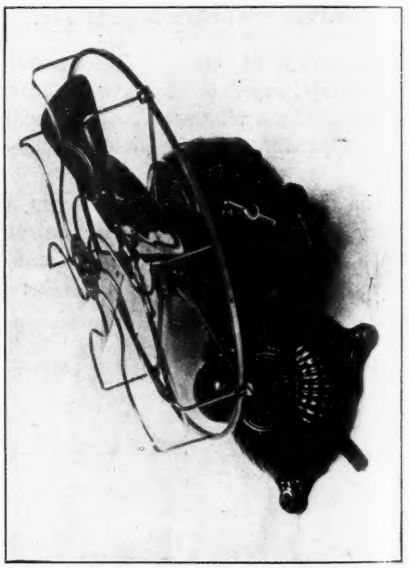


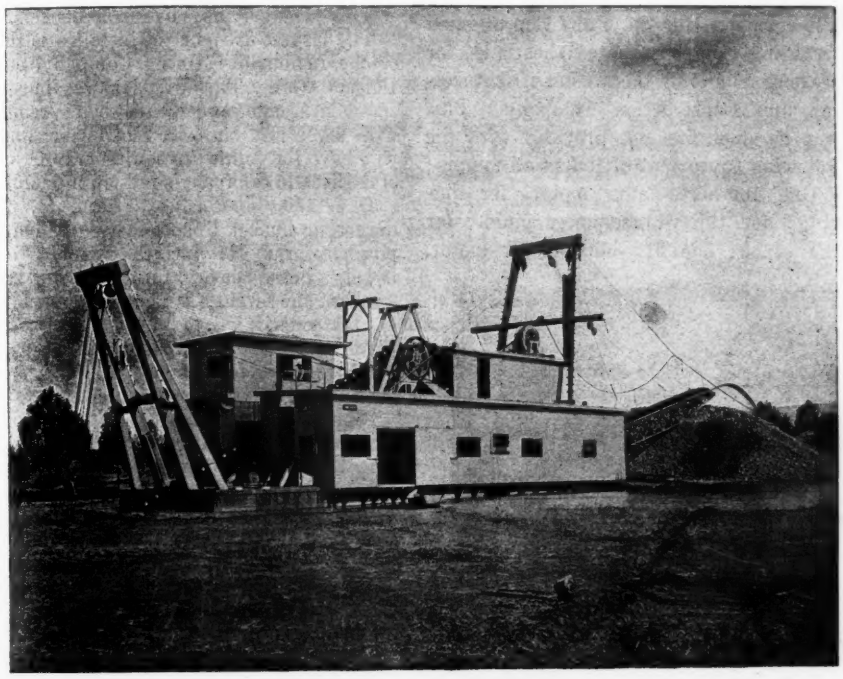
FIG. 3.—DIEHL UNIVERSAL PROPELLER FAN.

At a meeting of the Bath (England) town council it was announced that the Hon. R. J. Strutt thinks there are traces of radium in the Bath mineral water.

GOLD DREDGING.

BY C. WESTON CLARK.

The early placer mining in California was superseded by hydraulic working, but this was stopped by state legislation, due to the fact that the large quantities of soil washed down from the hydraulic mines filled up the rivers and worked injury to the farming and shipping industries. The gold dredger is the natural successor to these two modes of gravel mining, and with modern improvements business has assumed extensive proportions with the prospect of constantly increasing in the future. The first dredgers were operated by steam, but expensive operating made them successful only where rich ground could be worked. With cheap electric power, dredging land averaging less than ten cents a cubic yard is made profitable. Dredging is made a safe mode of mining because the ground can be carefully sampled before expensive investments are made. The gold-carrying soil varies from ten to fifty feet in depth, being a gravel deposit left in old river channels. Usually one or two holes to the acre are put down by the ordinary drilling machine, the value of the boring being carefully determined, and with the depth of the ground being known, a close estimate of the value of the gold-bearing soil can be determined.



DREDGE WORKING SAND PILE, DISCHARGING ON GRAVEL PIT IN THE REAR.

The two types of electric dredges which have been used secure the soil by either lifting it through centrifugal pumps or by an endless chain of buckets. The latter system seems to be the most favorable, and most of the improvements seem to be along the line of this type of dredger. A boat is built in a pit where it is to be operated, and the necessary machinery placed aboard. The pit is then filled with water to a depth of from twenty-five to forty feet. The boats are fed by a cable about 500 feet long, which runs from the shore to the boat. Generally these cables are arranged for three-phase, sixty-cycle current standard low voltage, but one or two of the boats are fed by a 4,000-volt, four-wire cable, which is carried directly to the boat and the transformers placed on the boat. The lower voltage cables are rubber insulated and triple braid waterproof. The 4,000-volt cables are leaded and armored. The transformers are sometimes placed on the boat and sometimes on a pole near the boat. Usually the latter arrangement.

The dredger digs its own channel ahead of it, depositing the soil which has been worked behind it. The soil is elevated into a grizzly or similar screening device where the rocks are washed from the soil, the rocks being delivered to the carrier that deposits them out of the way behind the dredger. The soil is then washed through shakers and riffles, leaving the gold deposited on saving tables to be taken up with quicksilver, and the worked-over soil is run out at the stern of the boat.

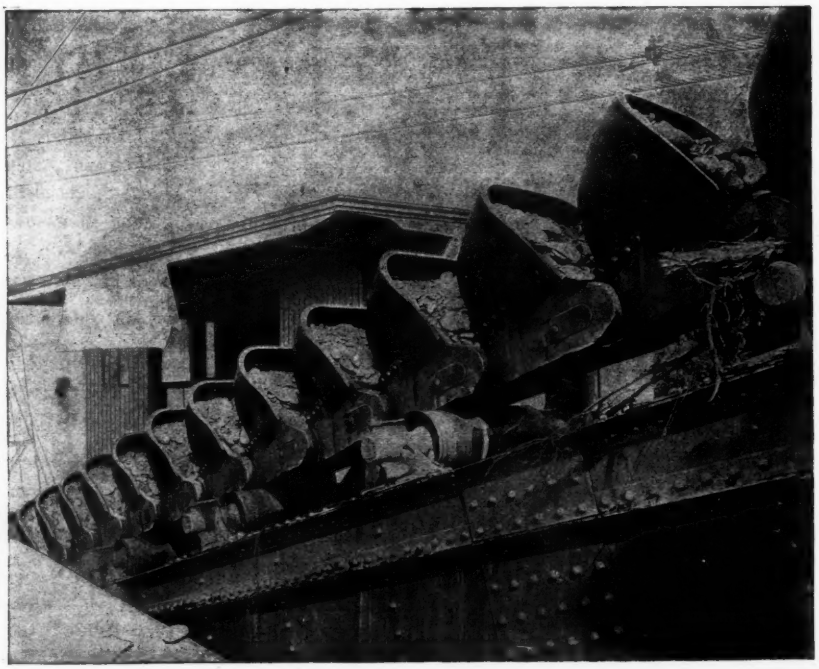
The General Electric Company, Schenectady, N. Y., has developed electric equipments for mining machinery of all kinds, and the electrically operated dredges recently equipped by that company are splendid examples of successful engineering enterprise.

A typical outfit recently sold to the Western Engineering and Construction Company for the Central Gold Dredging Company, of Oroville, consists of the following induction motors:

One fifty-horse-power motor, with controller and resistance for driving the bucket line; one fifteen-horse-power motor, with controller and resistance for operating the winches (this apparatus is

DREDGE COMING "HEAD-ON"—WORKED-OVER GRAVEL PILE IN THE REAR.

for working the head lines and changing the direction of the boat to suit the work); one forty-horse-power motor, direct-connected to a centrifugal pump (this pump furnishes water for washing the soil); one fifteen-horse-power motor to drive the stacker or conveying belt which disposes of the stones; one fifteen-horse-power motor for operating the shaking screens; one thirty-horse-power motor for operating the sand pump (this motor is worked occasionally when the sand accumulates too thickly at the back of the boat, and delivers it out on the rock pile through a long pipe); one three-horse-power motor for operating a deck and bilge pump, used for general washing purposes.



Bucket Line.

The buckets each carry three cubic feet of earth. A similar equipment of the chain bucket type is furnished the Butte Gold Dredging Company. This has eighty-five buckets to the chain, each bucket having a capacity of five cubic feet, and being operated at a normal speed of twenty-two buckets per minute. The dredge will dig from 50,000 to 75,000 cubic yards of material per month. There are some dredges using a three and one-half cubic foot bucket which will not exceed 50,000 cubic yards per month. The standard dredge, however, uses the five-foot bucket. This dredge has a hull about thirty-six by ninety feet on the water line, with a draft of five feet. It is fitted with two spuds—one wood, fifty feet long, weighing about ten tons; one steel, fifty feet long, weighing about seventeen tons. The swing permits of a cut about ninety feet in width. The bucket line can be run continuously to any point of the controller from the third notch to full speed. The stacker is thirty inches wide and about ninety feet long.

Another typical electrical equipment was furnished for the Yuba Consolidated Dredging Company, near Wheatland, for a dredger built by the Western Engineering and Construction Company. This is a five-foot dredger, provided with the following equipment of induction motors:

One 100-horse-power motor, for digging; one thirty-horse-power motor, for the winch; one fifty-horse-power motor, for the centrifugal pump; one twenty-horse-power motor, for the stacker; one twenty-horse-power motor, for screens; one seven and one-half horse-power motor, for the deck pump.

A similar outfit is furnished for the Folsom Development Company, at Folsom.

Another type of dredger is different from the foregoing one in that it is not equipped with variable speed motors on the digger. Four of these dredgers with three-foot buckets were furnished for the Boston & Oroville Gold Dredging Company and one for the Oroville Gold Dredging and Exploration Company, each having the following equipment of induction motors manufactured by the General Electric Company:

One fifty horse-power, one forty horse-power, two twenty horse-power, one ten horse-power, one 100 horse-power, one one horse-power.

Another dredger built for El Oro Gold Dredging Company, of Oroville, has the following motors:

One seventy-five horse-power, one thirty horse-power, one 100 horse-power, two forty horse-power, one twenty horse-power, one seven and one-half horse-power.

This dredger has five-foot buckets.

The largest dredger yet installed is that of the Ashburton Mining Company, near Folsom, Cal. This dredger was burned six months ago, and is now being rebuilt with seven and one-half foot buckets, and will have the following equipment of General Electric Company's induction motors:

One 150 horse-power, form M, for digger or bucket line; one twenty horse-power, form M, for the winch; one twenty horse-power, form K, for the stacker; one seventy-five horse-power, form K, for centrifugal pump; one ten horse-power, form K, for deck pump.

There have been many changes made from time to time in the details of the dredger, and experience has overcome most of the difficulties first encountered. The boat itself is properly proportioned to stand the tremendous strain brought upon it, the most effective arrangement of shakers and screens has been determined, and each part of the boat works in harmony with the rest. There are now about forty dredgers working in California and the business is rapidly growing.

Proceedings of the Ohio Electric Light Association.

The proceedings of the ninth annual meeting of the Ohio Electric Light Association, held at the Hotel Chittenden, Columbus, Ohio, October 13, 14 and 15, 1903, are being distributed in book form. This book is not intended only for the members of the association, but is for the benefit of all who may find use for a work of this nature. The book is well printed and is substantially bound in a light cloth cover. The publisher is Mr. Douglas A. Brown, Cincinnati, Ohio.

Calcium Carbide for Raising Vessels.

Calcium carbide has been put to an ingenious use for raising and sinking a submarine boat in Germany. The boat is supplied with an ordinary gas generator and a water tank, the upper part of which is connected with the generator. When it is desired to submerge the vessel, the water compartment is opened to the sea. As it fills with water, the boat sinks. To raise it, it is only necessary to connect the water chamber with the gas generator and admit water to the latter. The enormous volume of acetylene gas set free expels the water and brings the boat to the surface again. The apparatus is simple and has but little to get out of order.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TEXAS TELEPHONE ABSORPTION—E. H. Huntington has just closed a deal through Frank C. Smith, whereby he becomes owner of thirteen additional independent telephone exchanges in Texas. The new exchanges just purchased are the Austin, Taylor, Temple, Belton, Sour Lake, Saratoga, Kountz, Woodville, Village, Kirbyville, Coll, Jasper and Bronson, and the long-distance lines of the Commercial and Lone Star companies. The price paid for these, together with the Houston, Galveston, Corsicana, Nacogdoches, San Marcos, Port Arthur and Liberty exchanges, previously acquired, exceeds $1,000,000.

VICTORIA FALLS, ZAMBESI, TO BE DEVELOPED—A company has been formed to exploit Victoria falls, in the Zambesi, and will build a hydroelectric generating station, with the expectation of supplying power to the Waukie coal fields, Buluwayo, the Gwelo, Sebakive and Hartley gold fields, all of which are within 300 miles. The falls are over 400 feet high, and, while the total amount of energy running to waste at Niagara is 7,000,000 horse-power, the corresponding figure for the Victoria falls in the wet season is 35,000,000. The railway has now been completed to within seventy miles of the falls, and will reach them before the end of March.

TELEPHONE SYSTEM REORGANIZATION—The reorganization of the New Telephone Company, of Indianapolis, Ind., by which the lines and entire system of the company will be leased by the Indianapolis Telephone Company, will make it possible for the local company to extend its system and add 3,000 new telephones to the number now in use. It is stated that there are now nearly 8,000 telephones in the New Telephone Company's system, and that the company has 2,000 more subscribers on its books than it can accommodate. The Indianapolis Telephone Company will be incorporated for $1,200,000, and will have the same officers as those of the company it will absorb.

POWER PLANT DAMAGED BY ICE AND FLOOD—It was announced last week that the large power-house of the Yorkhaven Water and Power Company, at Yorkhaven, Pa., had been crushed by the high water and ice. The breaking of the clogged ice at Cly, and the back waters of the Yorkhaven below Conewago Falls caused the damage to the power-house. This plant has been in course of construction for a number of years, and over $1,500,000 had been expended thus far. Operations were to have commenced early next month. Very recently the company arranged to increase the capital stock to $5,000,000; York, Baltimore and New York capitalists being principally interested.

RAPID TRANSIT SUBWAY IN NEW YORK CITY TO BE OPENED IN JUNE—It is announced that formative plans are now under way to conduct an unusual celebration commemorating the opening of the New York rapid transit subway some time in June of the present year. Invitations will be extended to the President of the United States, cabinet officers, supreme court justices and others connected with the national government. Governor Odell, of New York, and the governors of other states and mayors of leading cities of this country and the principal cities of Europe will also be invited. Addresses will be delivered both by statesmen and the heads of the company undertaking the work.

ANOTHER MEXICAN POWER PLANT—An electric traction system is to be constructed in the mining town of Pachuca, located in the state of Hidalgo, and having a population of about 42,000 inhabitants. The Hidalgo Railroad Company, which operates a steam road between Mexico City and Pachuca, is completing the purchase of the mule tramways, about twelve miles long, and the same are to be electrically driven. An electric railway is to be built between Morelia, the capital of the state of Michoacan, and Guadalajara, the principal city in the state of Jalisco, Mexico. The length of the road, the building of which will be begun practically immediately, will exceed 120 miles. Archbishop Silva, of Morelia, is understood to be quite extensively interested in the enterprise. Carlos F. de Sandero, a Morelia engineer, has been appointed to obtain the usual government concessions.

PENNSYLVANIA TUNNEL CONTRACTS AWARDED—The Pennsylvania Railroad Company has awarded the contract for boring the tunnel under the North river, connecting Jersey City with the borough of Manhattan, New York, to the O'Rourke Engineering Construction Company. The tunnel under the East river will be constructed by the firm of S. Pearson & Son, of London, England. The tunnel under the North river will consist of two cast-iron tubes, each twenty-three feet in diameter and 6,000 feet long. The North river tunnel of the New York & New Jersey Railroad Company has been completed. Mr. William G. McAdoo, president of the company, and a party of engineers, on Friday, March 11, made a preliminary trip through the tunnel underneath the North river, from Jersey City to New York, shortly after the two ends of the tunnel had been joined together and this preliminary work finished. Among those in the party were Vice-president W. G. Coleman, Chief Engineer C. M. Jacobs, and directors John Skelton Williams and G. Tracy Rogers, of the tunnel company; William Barclay Parsons, chief engineer of the Rapid Transit Commission; Thomas N. McCarter, president of the Public Service Corporation of New Jersey; Francis R. Pemberton, of Pemberton & Company, bankers; C. S. Shepard, E. R. Green, H. P. McCullough, W. H. Moir, Charles W. King, Dr. A. J. Loomis, George B. Frye, Patrick Fitzgerald and Kenyon B. Conger.

TELEPHONE AND TELEGRAPH.

SAN DIEGO, CAL.—The Sunset Telephone Company is constructing a line to Ramona.

PORT BYRON, ILL.—A new independent telephone company has been organized here by Daniel Eipper, Frank Morgan, Stephen Allen, D. Y. Allsbrow, R. M. Savage and S. Sturdevant.

MANKATO, MINN.—The Mankato Citizens' Telephone Company has made arrangements to connect with the Minnesota Valley Farmers' Mutual Telephone Company, operating in South Bend, Judson and vicinity.

NASHVILLE, TENN.—The Cumberland Telephone and Telegraph Company has asked permission of the city to place its wires within the city limits underground, and to make the necessary excavations in the streets for this purpose.

APOLLO, PA.—The Cowanshannock Telephone Company has completed connections with the Apollo line, giving the people of this vicinity through connections with Indiana, Kittanning, Punxsutawney and the country towns in three counties.

MINNEAPOLIS, MINN.—The Twin City Telephone Company, in connection with the Tri-State Telephone Company, an affiliated concern, has purchased three lots in this city, and will erect a large long-distance exchange, costing from $50,000 to $100,000.

SPRINGFIELD, MASS.—The Alford Cooperative Telephone Company has organized by electing the following officers: Monroe Eastland, president; Walter Mann, vice-president; William Milligan, secretary, and Frank Kline, treasurer. The company will build a line from Alford to State Line, N. Y.

DAVENPORT, IOWA—At the annual meeting of the stockholders of the Union Telephone Company, the entire board of directors was reelected, with the addition of Frank P. Welch, of Rock Island. The following officers were unanimously elected: president, N. Hamilton; secretary, C. A. Lee; treasurer, John W. Morrison.

KANSAS CITY, MO.—Workmen at Independence have begun the construction of a new telephone line to St. Louis by way of Sedalia. The line is to be used in connection with the new Independence Home Telephone Company, which has connections with the Home Telephone Company, of Kansas City. It will follow the rock road to Blue Springs, thence east toward Sedalia.

WOODSTOWN, N. J.—At a meeting of the farmers held here recently, the Piles Grove Rural Telephone Company was organized, with George W. Waddington, president, and Charles F. Pancoast, secretary. The new company will furnish telephone service to

farmers in Salem County, and plans to connect with the wires of the Bell and Interstate companies in Gloucester.

GLASGOW, KY.—The Bowling Green Home Telephone Company will build a line to Scottville in the spring.

KENOSHA, WIS.—The Citizens' Telephone Company has completed the work of installing its plant in this city.

SPRINGVILLE, N. Y.—The Commercial Telephone Company has been consolidated with the Springville Telephone Company.

DUBLIN, GA.—The Western Union Telegraph Company has placed in operation a direct line from Savannah to Dublin.

CANASTOTA, N. Y.—The Central New York Telephone and Telegraph Company will install an automatic system in this city.

CHICAGO, ILL.—A government cable is to be laid between North Manitou Island and Beaver Island, with the land end at Glen Haven, Mich.

COLUMBUS, OHIO—The Waldo Home Telephone Company has been incorporated by W. Kingle, A. Osborn, M. Lewis, W. D. Kraner and S. Schwaderer.

SHELL LAKE, WIS.—A telephone line has been completed placing Shell Lake in direct connection with Clam Falls, in Polk County, twenty-five miles west.

VERGENNES, VT.—At a meeting of the independent telephone companies of northern and middle Vermont, at St. Johnsbury, it was decided to establish a trunk line from St. Johnsbury to Montpelier.

DULUTH, MINN.—It is stated that extensive improvements will be made this spring to the Hibbing exchange of the Mesaba Telephone Company, and that a line will be erected from Grand Rapids to Nashwauk.

WINNIPEG, MANITOBA—The Canadian Pacific Railway will string another duplex wire through to Montreal, and a new copper wire west from Winnipeg to Regina. A new line of poles will be erected along the Northwestern section from Portage la Prairie, replacing the old Manitoba and Northwestern line.

SAVANNAH, GA.—At a meeting of the Whetstone Telephone Company, held in Lake City, Fla., the name of the company was changed to the Columbia Telephone Company, and the following officers elected for the ensuing year: president, W. N. Shine; vice-president, M. M. Scarborough; treasurer, M. A. Shine.

NASHVILLE, TENN.—At a recent meeting of the Cumberland Telephone and Telegraph Company the old officers were elected, as follows: James E. Caldwell, president and general manager; W. W. Berry and William Litterer, vice-presidents; Leland Hume, secretary and assistant general manager; T. D. Webb, treasurer; H. Blair Smith, auditor.

QUINCY, MICH.—The Quincy Independent Telephone Company has been organized, the object of the new company being to put in and maintain an independent telephone exchange in Quincy. Connections will be made through Allen and Jonesville with Jackson, Detroit and Toledo, and with the Himebaugh system, which will be extended to Quincy from Coldwater.

STERLING, ILL.—Representatives of the telephone companies of Morrison, Prophetstown, Rock Falls and Tampico held a meeting in Tampico recently and decided to consolidate the companies under one name, the concern to be known as the Whiteside County Mutual Telephone Company. The company will have a capital not larger than the combined capital of the various companies as they now exist.

ELMIRA, N. Y.—The York State Telephone Company, of this city, has made connection with its exchange at Binghamton, where it has 2,000 telephones in operation. This connection gives the company's subscribers connection with Ithaca, Cortland, Syracuse, Oswego, Utica and all intermediate points. The company has completed connections to Penn Yan, Geneva, Canan[illegible]gua, Lockport, Batavia, Buffalo, Tonawanda, Niagara Falls, Horn[illegible] Wellsville, Salamanca, Jamestown, Waverly, Towanda, Tu[illegible] Scranton and Wilkesbarre, and in the near future lines already built will be perfected to Albany, Troy, Saratoga, Johnstown, N. Y.; Philadelphia and Pittsburg, Pa.; Camden, Trenton, Atlantic City, N. J., and through all parts of New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia, Ohio, Indiana, Illinois and Michigan.

PERSONAL MENTION.

THE HON. W. W. GUEST has been elected president of the Lancaster County Railway and Light Company, Lancaster, Pa.

MR. T. W. SHELTON, chief engineer of the Northern Ohio Traction and Light Company, Akron, Ohio, has resigned his position.

MR. L. R. NOTBOHM has resigned his position as superintendent of the Washington Water Power Company, at Spokane, Wash.

MR. F. L. FULLER, general manager of the New York & Queens County Railway Company, has been elected vice-president of the company.

MR. L. P. BAKER, of the engineering department of the Baltimore & Ohio Railroad Company, has been appointed division superintendent on the Erie Railroad.

MR. B. C. KENYON, who has been general manager of the Diehl Manufacturing Company, Elizabethport, N. J., for some time past, was recently elected president of the company.

MR. W. W. WAINWRIGHT, M. E., of Connersville, Ind., has opened a small plant for the construction of experimental machinery in connection with his consulting engineering practice.

MR. THOMAS O'CONNOR, formerly connected with the Boston fire department, has been appointed chief of the private fire department of the General Electric Company's plant at Schenectady, N. Y.

MR. WILLIAM LINTERN has resigned as master mechanic of the Cleveland & Southwestern Traction Company, Cleveland, Ohio, to accept a position with the Nichols-Lintern Company, also of Cleveland, Ohio.

PROFESSOR ROBERT BOWIE OWENS, E. E., M. A., D. Sc., F. R. S. C., who is president of the electrical section of the Canadian Society of Civil Engineers, has been made a member of the council of the society.

MR. ROBERT T. E. LOZIER, who was connected with the Bullock Electric Manufacturing Company, Cincinnati, Ohio, for some time past, has tendered his resignation to enter into electric motor work on his own account.

MR. T. W. CROWLEY has been appointed superintendent of the telegraph system of the Delaware & Hudson Railroad Company, to succeed Mr. J. A. Burdick, who has been transferred to another position with the company.

DR. E. C. KILBOURNE, of Seattle, Wash., has resigned his position with the Union Electric Company, and will become a partner in the Kilbourne-Clark Company, which, it is said, is one of the largest electrical supply concerns on the Pacific coast.

MR. JOHN F. DUSMAN, who was chief electrician of the York County (Pa.) Traction Company and the York Street Railway Company, has tendered his resignation to accept a position with one of the street railway companies of Baltimore, Md.

MR. A. KENNEDY ASHWORTH, assistant manager of the Underfeed Stoker Company, Chicago, Ill., has resigned his position to accept the New England agency of the Buckeye Engine Company, Salem, Ohio. Mr. Ashworth will make his headquarters at Boston, Mass.

MR. GEORGE H. CAHILL, formerly superintendent of the Public Service Company's electric railway lines, Bayonne division, New Jersey, has resigned to accept the position of superintendent of the New Paltz, Highland & Poughkeepsie Electric Railway, of Poughkeepsie, N. Y.

MR. EDWARD N. LAKE, formerly connected with the Western Electric Company, and more recently connected with the engineering staff of the Chicago Edison Company, has been appointed manager of the switchboard department of the J. Lang Electric Company, Chicago, Ill.

MR. HARRY D. PARSONS, who was superintendent of construction and electrician for the Meridian (Miss.) Light and Railway Company for some time past, has tendered his resignation to accept

a position as salesman of the Commercial Electrical Supply Company, St. Louis, Mo.

MR. W. D. RAY, 312 Electric Building, Cleveland, Ohio, has severed his connection with the Westinghouse Traction Brake Company, as Central States representative, to enter the steam specialty market. He will represent several well-known manufacturers in the sale of high-grade steam specialties.

DR. MARGARET A. CLEAVES, who is well known in the field of electrotherapeutics, and the author of a number of excellent articles on this subject, has had reprinted from the *Journal of Advanced Therapeutics* of February, 1904, a study of "The Physiological Action of Light and the Physical Factors in Phototherapy."

MR. BENJAMIN S. HANCHETT, of Grand Rapids, Mich., who is secretary and treasurer of the Grand Rapids Railway Company, and president of the Grand Rapids, Holland & Lake Michigan Interurban Company, will succeed, it is reported, the late G. Stewart Johnson as manager of the Grand Rapids Street Railway Company.

MR. EDWIN C. FINLEY, assistant engineer (in charge of railway construction) to Mr. Richard H. Phillips, chief engineer of the St. Louis Exhibition, has tendered his resignation to accept the position of superintendent of the railway division in the department of transportation exhibits. Mr. Finley will be succeeded by Mr. C. H. Coleman.

MR. AND MRS. GEORGE A. McKINLOCK, with their son and Master Teddy Brown, sailed on Saturday, March 12, on board the Canopic for Italy. They will return to the United States about the first of May. Mr. McKinlock, who is president of the Central Electric Company, of Chicago, is quite an old-world traveler, but on this occasion will confine his trip to the points of interest in Rome and interior Italy.

MR. FRANK C. MASON, superintendent of the Police Telegraph Bureau, of the city of New York, will resign his position in a short time. Mr. Mason has been associated with the department for twenty years, and brought about the model system adopted by the police department of New York. He will retire to private life on a substantial pension, to which he is entitled for his long career in the city service. Mr. Mason is one of the best-known figures at all the conventions of the municipal electricians, and has a host of friends in the electrical fraternity.

MR. CHARLES L. EDGAR, president of the National Electric Light Association, was in New York several days last week looking after association affairs. President Edgar was accompanied by past president James I. Ayer, who will act as chairman of the entertainment committee of the twenty-seventh convention, to be held in Boston, May 24 to 27. The entertainment committee, among its other duties, will have charge of assigning rooms at the Vendome, which is to be the headquarters of the association, and particulars regarding rates, etc., will be issued very soon. As many delegates prefer to stop at a smaller or quieter hotel than that selected for convention headquarters, arrangements will be made by which they also can secure through the committee such accommodations as they prefer.

LEGAL NOTES.

DECISION ON THE LANGE PATENT—In the United States Circuit Court of Appeals for the Third Circuit, in the suit on the Lange patent for standard socket fastening, the court holds that the Circuit Court was right in holding that the claims in suit were valid, and that they had been infringed by the appellants; and the decree of the Circuit Court was affirmed, with costs, in favor of the Bryant Electric Company, of Bridgeport, Ct.

TESLA SPLIT-PHASE MOTOR DECISION—In the suit of the Westinghouse Electric and Manufacturing Company, complainant, against the Mutual Life Insurance Company, of New York, and H. C. Mandeville, defendants, brought to establish infringement of the Tesla patents Nos. 511,559 and 511,560, Judge Hazel, in the United States Circuit Court, Western District of New York, on February 9, held that the patents in suit were valid, and allowed the complainant a decree in the usual form, with costs and disbursements.

ELECTRICAL SECURITIES.

There have been few weeks in the history of modern business developments when the stock market experienced as great an apathy and as short a line of business as last week. This was so evident each succeeding day during the week that it attracted widespread comment throughout the country. Professional sentiment is bearish in the extreme, and the hope is advanced that the strong feeling following the adverse Northern Securities decision will have a brightening tendency. While prices have reached a decidedly low level for this time of the year, the disinclination of all classes of financiers to do more than let well enough alone makes it possible that values will seek still lower points. The government foreign reports for February, both in imports and exports, might be considered unfavorable, and these reports form a prominent factor in establishing confidence or apprehension.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MARCH 12.

New York:	*Closing.*
Brooklyn Rapid Transit	39⅜
Consolidated Gas	189¼
General Electric	159
Kings County Electric	183
Manhattan Elevated	140¼
Metropolitan Street Railway	106⅝
New York & New Jersey Telephone	142
Westinghouse Manufacturing Company	175

The board of directors of the Western Union Telegraph Company has declared a quarterly dividend of 1¼ per cent upon the capital stock of the company, payable on and after the fifteenth day of April to shareholders of record at the close of the transfer books on the nineteenth day of March. For the quarter ended March 31, 1904, the estimated net revenue of the company is $1,700,000, and the surplus $246,683. This compares with a net revenue of $1,842,269 and a surplus of $338,955 for the same period of the preceding year.

The annual report of the Brooklyn Rapid Transit Company for the year ended December 31, 1903, is as follows: gross, $14,025,825; operating expenses, $8,392,607, leaving net of $5,633,217; other income, $207,512, a total of $5,840,739; taxes, interest and rentals, $4,702,513, and special appropriations, $338,611, leaving a surplus of $799,614. The company's balance-sheet for the year ended December 31, 1903, shows total assets of $119,795,372 and total liabilities of $117,137,647, the surplus amounting to $2,657,725.

Boston:	*Closing.*
American Telephone and Telegraph	121
Edison Electric Illuminating	234
Massachusetts Electric preferred	72
New England Telephone	118
Western Telephone and Telegraph preferred	78

Philadelphia:	*Closing.*
Electric Company of America	7¾
Electric Storage Battery common	52
Electric Storage Battery preferred	52
Philadelphia Electric	5¾
Union Traction	47¼
United Gas Improvement	82⅜

The annual meeting of the stockholders of the Philadelphia Electric Company will be held on April 13, at Camden, N. J.

The directors of the United Gas Improvement Company have declared a quarterly dividend of 2 per cent ($1 per share), payable April 15, 1904, to stockholders of record at the close of business March 31, 1904.

A dividend of $2 per share has been declared on Philadelphia Traction stock, payable April 1 to stock of record March 11.

Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	148
Metropolitan Elevated preferred	43½
National Carbon common	25
National Carbon preferred	98
Union Traction common	5
Union Traction preferred	30

ELECTRIC LIGHTING.

DANBURY, IA.—Citizens are agitating the question of putting in an electric light plant.

KEMPS CREEK, ALA.—Frank F. Taylor will install an electric lighting system in this village.

MOLINE, ILL.—The city council has authorized the placing of thirty additional lights in the city streets.

STATTVILLE, N. Y.—The Albany & Hudson Railroad has entered into an agreement to light the village streets.

CHATTANOOGA, TENN.—The Chattanooga plow works will install an electric plant and generate its own power.

OMAHA, NEB.—The city council has ordered twenty-two new arc lights placed at various points, at an annual cost of $2,100.

CONCORD, N. H.—The Blackwater Power Company, of Webster, with a capital of $20,000, has filed articles of incorporation at the office of the secretary of state.

ALBANY, N. Y.—The governor has signed a bill authorizing an election in the village of Philadelphia to determine the question of installing a village lighting plant.

GEORGETOWN, ILL.—The village board has granted a franchise for an electric light plant. The franchise provides for the completion of the system in nine months.

SALEM, N. Y.—The Salem Electric Light and Power Company has completed arrangements for improving its plant. New apparatus of the latest type is to be installed.

WILKESBARRE, PA.—At a special meeting of the common council franchises were granted to the West Side Electric Light Company and the Ashley Light Company.

NANAIMO, B. C.—The Nanaimo Electric Light Company is endeavoring to secure water rights on the Millstone river, so as to generate electricity for its plant by this method.

SHELL LAKE, WIS.—The application of this town for a $10,000 loan from the trust funds of the state has been accepted by the commissioners, and electric lights will be installed.

ONTARIO, ORE.—E. H. Test and A. N. Soliss, who have a franchise from the city council for an electric light and power plant, are taking steps toward installing the plant at an early date.

HAGERSTOWN, MD.—Gettysburg town council has awarded the lighting contract for that town to the Keystone Electric Light Company for a period of five years at the rate of $59.59 per light.

OLEAN, N. Y.—The Warsaw Gas and Electric Company will soon install a new direct-current dynamo and an entirely new outfit of enclosed arc lamps for the street lighting service of the village.

BENTON HARBOR, MICH.—This city has closed a contract with the Benton Harbor-St. Joseph Electric Light Company for 115 1,200-candle-power lights at $47 a light. The city has been paying $70 a light.

CANTON, MO.—The town board of trustees has let the contract for the new electric light plant for the sum of $8,948, complete. The building has already been erected, and it is hoped to have the plant in operation in eighty days.

WOONSOCKET, S. D.—A franchise has been granted by the city council to local men for a system of electric lights and steam heating. The plant will cost $10,000, and the money is being raised by popular subscription to the stock.

DUBUQUE, IOWA—Negotiations are under way for the sale of the Dyersville electric light plant to a company of Hamilton, Ohio. The capacity of the plant is not sufficient to supply the town, and it will be enlarged in the event of the new concern getting control.

GEORGETOWN, CAL.—Negotiations are under way with the American River Electric Company to extend a line from a point near the Delmatia mine, in the Kelsey district, to Georgetown for power and lighting purposes. The line will be about nine miles in length.

MUSKOGEE, I. T.—The light and power plant, ice plant and a gas franchise here have been sold to a Chicago company. This plant was the first electric light plant built in the Indian Territory. The consideration was $125,000. The Chicago company will also put in a street car system.

NEW CASTLE, KY.—The board of trustees has granted a franchise to the New Castle Electric Light, Heat and Power Company, which will at once begin the work of installing its system. The company is a branch of the company which is putting in a plant at Eminence, four miles distant.

ST. LOUIS, MO.—The Upper Alton village board has received a proposition from the Alton Light and Traction Company to furnish additional street arc lamps for the village. In consideration of a reduced price the company asks for a five-year contract and a franchise for laying gas mains in the village streets.

BATH, N. Y.—Owing to the fact that the present equipment of the Bath electric light plant is proving inadequate to meet the demands made upon it, the owners have decided to install a new dynamo of 2,500-light capacity, a new 150-horse-power boiler, a 250-horse-power engine and other needed equipment.

NEENAH, WIS.—The Wisconsin Traction, Heat, Light and Power Company, operating the electric interurban line between Neenah and Kaukauna, has petitioned the city council for a franchise to light the city. The company offers to furnish street lights at $65 per annum on an all-night schedule. The lighting contract is worth $6,000 a year. The company asks a thirty-year contract.

BANGOR, ME.—A. F. Gerald has nearly completed an important work of electric power development on the Sebasticook river between Benton and Clinton, where he has erected a dam 300 feet long and twelve feet high, and a canal 2,000 feet long, with twenty-three feet head. Wheels are now being set and the plant will be ready for operation May 1. About 1,500 horse-power will be developed, and this will be utilized in several ways, including the operation of the car line between Fairfield and Waterville, and several factories in Clinton, Benton and Fairfield.

KANSAS CITY, MO.—The poles of the electric light company in the retail business district, with the exception of those used for the lights of the city, are to be removed. Where the company has conduits they will be used for carrying the wires, and on all other streets the trolley poles of the Metropolitan Street Railway Company will be pressed into service. To each trolley pole an extension arm will be attached and on these arms the wires will be strung. The action of the company is due to the provisions of an ordinance recently passed by the city council.

CARLISLE, PA.—The power plant on the bank of the Susquehanna at Riverton, now the property of the Valley Traction Company, is to be completely reconstructed and improved. An extension to the building is now being erected, and the enlarged engine room will be 125 feet by 57 feet. Four new direct-connected engines will be put in and five new Babcock boilers. This will be practically a new plant, with the old plant held in reserve for emergencies. This plant runs the trolley lines and also the electric lighting lines which supply Mechanicsburg and the lower end.

WILMINGTON, DEL.—The annual report of the street and sewer department shows that, out of the $100,000 appropriation, $41,693.74 was expended for lighting the city. There were on February 1, 1903, 298 arc lamps of 2,000 candle-power each burning during the entire night, and during the year ending January 31, 1904, there were fifteen new arc lamps placed in position, making the present number 313. These lamps cost $64.92 each per year. The itemized expense account for lighting for the year follows: arc electric lighting for the year, $19,917.27; incandescent electric lighting for the year, $6,901.83; American Lighting Company, incandescent gas lamps for the year, $13,307.98; plain gas lighting for the year, $1,566.66. The present demand for arc lights is great, especially in the southern and eastern sections of the city.

ELECTRIC RAILWAYS.

MOUNT HOLLY, N. J.—The Burlington County Trolley Company is considering the matter of extending its road from this place to Pemberton by way of Smithville.

ST. LOUIS, MO.—The Southern Illinois Electric Railroad Company has purchased a site at Okawville, on which to erect a power-house. One will also be erected at Irvington.

NEW CASTLE, IND.—The city council has granted a franchise for an electric line from this city to Richmond, *via* Haggerstown, a distance of eighty-nine miles, to Charles N. Mikles.

LOUISVILLE, KY.—The Louisville & Nashville Railroad Company's narrow-gauge line to Prospect has been leased to the Louisville Railway Company, which will fit it up for electrical operation.

NEW HAVEN, CT.—The contract for building the Groton & Stonington street railway has been awarded to the John B. Macafee Company, of Philadelphia. The road is to be completed and in operation by July 1.

CHIPPEWA FALLS, WIS.—The Chippewa Valley Electric Railway Company has mortgaged its property for $750,000 to the Security Trust Company, Camden, N. J. Of the sum, $250,000 will be used for building new lines.

VINELAND, N. J.—Representatives of a trolley company are getting the right of way to open up the farming district between this place and Bridgeton, which will also take in the towns of Norma, Alliance, Brotmanville, Rosenhayn and Carmel.

COLUMBUS, GA.—W. Miller Gordon, president of the Birmingham, Columbus & St. Andrews Railway, announces that work on that road will commence in a few weeks. The line from Chipley, Fla., to St. Andrews, a distance of fifty miles, will be built first.

PASSAIC, N. J.—The Hudson River Traction Company, it is reported, has made the necessary arrangements to run cars direct from Hackensack to Passaic. The line will branch off from a little to this side of the centre of Hackensack and connect at Lodi with the present lines of the Public Service Corporation.

FALL RIVER, MASS.—Frank H. Walker, of Newton; Benjamin W. Carlow, Henry M. Brett and N. Lewis Sheldon, of Boston; John M. Reed, Arthur M. Reed and Thomas E. Borden, of North Westport, and Algren O. Tripp and Augustus R. Wood, of Westport, have incorporated the Westport Street Railway Company with a capital of $100,000. The length of the road, which will be entirely in Westport, will be about twelve miles.

ARKANSAS CITY, KAN.—L. H. Northrup, who is promoting an interurban railroad between Winfield and Arkansas City, Kan., and between Arkansas City and the Indian schools at Chilocco, Okla., has made a contract with a St. Louis company for the construction of the road, and work will begin in the spring. It is expected that the cost will be between $500,000 and $600,000. The power-house, general offices, etc., will be built at Arkansas City.

INDIANAPOLIS, IND.—The work in Wabash on the Indiana Northern Traction Company's line from Marion to Wabash, which will connect with the Wabash-Logansport line, is now practically completed, and the prospects for immediately completing the grading are excellent. Construction is now being pushed as rapidly as possible, and the company hopes to have the road in operation by June 1.

BOSTON, MASS.—The Berkshire Street Railway Company at a special meeting held recently voted to increase its capital stock from $800,000 to $1,000,000. The quarterly report of the company for the quarter ending December 31, 1903, shows gross earnings of $417,047, and net earnings of $129,033. The surplus amounts to $53,979, as compared with $64,511 for the same quarter of 1902.

BROOKLYN, N. Y.—The franchise of the New York & Long Island Traction Company, granted by the board of aldermen, permitting it to lay twenty-five miles of track into the town of Jamaica, has been filed in the Queens County court. The first six miles of track are to be laid by January 1 of next year, and the entire road completed by July 1 following. The company is successor to the Hempstead, Mineola & Freeport Traction Company.

CINCINNATI, OHIO—The Blue Grass Traction Company, which operates a line from Lexington to Paris, Ky., and the Lexington & Georgetown Traction Company, which operates a line from Lexington to Georgetown, Ky., has been consolidated, with Yunger Alexander as president. A. S. Rice, vice-president of the Equitable National Bank, is to be the secretary and treasurer. The capital stock will be $750,000. The stock in both companies is owned practically by the same parties.

EDWARDSVILLE, ILL.—The Okaw & Eastern Railway, with principal office at East St. Louis, has been incorporated in Springfield. Its object is to construct a road from East St. Louis east through the counties of St. Clair, Madison, Clinton, Bond, Marion, Fayette, Clay, Effingham, Jasper, Richland, Crawford and Lawrence, to a point near the Wabash river. The incorporators and first board of directors are: James L. Brown, Lincoln; M. E. Rountree and Duncan M. Stansbury, St. Louis; W. S. Forman and H. L. Browning, East St. Louis.

SAN JOSE, CAL.—The Santa Clara Valley Transit Company has been incorporated by F. M. Lockwood, J. A. Mepling, V. A. Scheller, W. C. Andrews and A. D. Cutler, with a capital stock of $1,000,000. The company purposes to construct an electric railway between this city and Alviso, and to run a line of light steamers from Alviso to San Francisco. From Alviso the railway will be continued to Palo Alto, with branches from the main line to the bay of San Francisco and to the town of Milpitas, the length of the entire road to be twenty-five miles.

BESSEMER, ALA.—The promoters of the proposed trolley line from Bessemer to the Blue Creek and Blocton districts have organized a committee composed of the following business men of Bessemer: S. E. Jones, W. W. Hollingsworth, W. P. Gunn, W. J. Parkes, J. J. Sullivan, R. F. Smith, W. L. Rush, T. Y. Huffman, W. H. Lewis, Jacob Marks, W. H. Dennis and C. L. Odell. Surveys will begin at once. The line to Blue Creek, about twelve miles in length, will be built first, and then the work of building to Blocton will be taken up. The latter section will be about twenty miles long.

OMAHA, NEB.—An organization has been perfected under the name of the Omaha & Southwestern Railway Company, which will this spring construct an electric freight and passenger railway from the Union Stock yards at South Omaha to Papillion. The officers of the company are W. H. Elbourn, president; Edward S. Streeter, vice-president; Charles E. Miller, secretary and treasurer; Lyman Waterman, manager. The company has a capital of $250,000. Right of way has been secured and surveyed between the points named, and contracts have been let for a part of the material for the road.

CORTLAND, N. Y.—It is thought that work on the Ithaca-Cortland Railroad will be commenced as soon as the weather will permit, and that it will probably be completed throughout its entire length from Ithaca to this city, by the way of Dryden, this season. A $650,000 mortgage has been entered in the county clerk's office at Ithaca by the railroad company in favor of the West End Trust Company, and this amount will be used to begin the construction of the road. The company has nearly completed securing rights of way over highways and nothing now seems to stand in the way of building the road.

HARTFORD, CT.—The franchise of the Windsor Locks & Rainbow Street Railway Company has been taken over by Tucker, Anthony & Company, of Boston, the syndicate which controls the Hartford & Springfield Street Railway Company. The deal was effected in Boston, and as a result of the transfer a through trolley line between Hartford and Springfield on the west side of the Connecticut river will shortly be built. The new owners of the corporation have organized with the election of these directors and officers: Directors—William A. Tucker and S. Reed Anthony, of Boston; Arthur Perkins, of Hartford; Frank E. Healy, of Windsor Locks, and Henry A. Huntington, of Windsor. President, William A. Tucker; secretary, Arthur Perkins; treasurer, S. Reed Anthony. The Windsor Locks & Rainbow Street Railway Company, which is capitalized at $100,000, holds a franchise to build a trolley line from the tracks of the Suffield Street Railway Company, in Suffield, through the town of Windsor Locks and into the town of Windsor, where connections can be made with the Hartford Street Railway Company. The distance is about ten miles, and connection with the Hartford trolley system will be made in Windsor centre and not at Rainbow. The syndicate will build the road at an early date, and the present intention is to have the line in operation this summer.

INDUSTRIAL ITEMS.

JAMES CLARK, JR., & COMPANY, Louisville, Ky., is calling attention to a number of very practical portable electrical tools in a neat bulletin which it has just issued.

McLEOD, WARD & COMPANY, 27 Thames street, New York city, N. Y., is sending out its catalogue in which is listed a line of desk, orchestra and pulpit lamps. Catalogue will be sent on request.

THE CALCULAGRAPH COMPANY, 9-13 Maiden lane, New York city, N. Y., has issued two interesting booklets treating on the calculagraph which it manufactures. These booklets will be sent on request.

THE WESTERN TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., is announcing to its customers and friends the removal of its quarters from Winthrop Harbor to 42 West Jackson Boulevard, Chicago, Ill., where all mail and shipments should be addressed.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., selling agent for "Zenith" lamps, is again mailing to the trade a handsome descriptive catalogue. The company invites all who have so far failed to receive one of these to make a request for same.

THE OKONITE COMPANY, LIMITED, 253 Broadway, New York city, announces that Mr. Carlos G. Palacios, of Caracas, Venezuela, has just placed a large order for wire for the La Guayra electric light plant.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., announces that it has a large stock of Diehl direct-current fan motors on hand. The company sold these fans throughout 1903, and states that the entire output has given full satisfaction. It anticipates an increased sale for 1904, and invites intending purchasers to write for prices.

THE NILES-BEMENT-POND COMPANY, 136 Liberty street, New York city, N. Y., has issued a new and handsome catalogue illustrative and descriptive of the "Niles" electric traveling cranes. This catalogue contains many fine half-tones of electric cranes, varying in capacity from 10 to 125 tons. Catalogue will be sent on request to prospective buyers.

THE MARSHALL-SANDERS COMPANY, Boston, Mass., reports a very brisk demand for its slate-base Baby knife switches. The company is also experiencing a large demand for its Midget plugs and receptacles. The Midget plug and receptacle is used extensively for fan motor connections, and is one of the simplest and most economical receptacles made.

G. M. GEST, the expert subway contractor, New York and Cincinnati, has closed with B. M. and J. F. Shanley, of Jersey City, N. J., a contract for laying their conduits in Harrison, N. J., and Kearney, N. J. Mr. Gest was recently awarded the contract to lay the forty-duct conduit for the Public Service Corporation of New Jersey. This contract will amount to thousands of dollars.

THE KNOWLES STEAM PUMP WORKS, New York, N. Y., has issued to the trade a catalogue descriptive of pumping machinery for beet sugar factories. There is a wide choice of apparatus for use in this field, and the Knowles company aims to have its pumps meet every requirement. In addition to the cataloguing of the special apparatus for this purpose there is considerable information with regard to the processing of beet sugar.

THE NATIONAL ELECTRIC COMPANY, successor to the Christensen Engineering Company, manufacturer of air brakes and electrical machinery, announces that it has just moved its executive offices and engineering department to its new building, located at the works at Milwaukee, Wis. The company is also making extensions and improvements in its shops to supply the necessary facilities for handling its increasing business.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, has placed on the market a new fireproof material known as "ceilinite." This is designed especially for fireproofing the ceilings in electrical cars, for which purpose it is being used by the Pennsylvania Railroad Company and the Interborough Rapid Transit Company. This material may be used for lining apparatus, ceilings, side walls, and at any point where a flexible fireproof barrier is required. It is made from specially prepared asbestos, in pieces one-eighth to three-eighths inch thick, thirty-six inches wide and about fifty feet long. Samples and prices may be obtained from the manufacturer's offices in New York, Milwaukee, Chicago, St. Louis, Boston, Philadelphia, Pittsburg, Cleveland, Indianapolis and London, England.

THE "BIG FOUR" ROUTE, through its general passenger and ticket agent, Mr. Warren J. Lynch, Cincinnati, Ohio, is distributing some interesting information with regard to the St. Louis World's Fair. In a large folder which gives a comprehensive résumé of the attractions which will be found at the fair, there are the usual topographical maps and a map of the United States showing the "Big Four" system and its connections with St. Louis. There are also through train schedules from Boston, Albany, New York, Niagara Falls, Buffalo and eastern points *via* Cleveland, and detailed information with regard to car service. A specially important book which the company has prepared is a "Hotel and Boarding-house Guide." This gives a list of the hotels, boarding houses and rooming houses in the business section of St. Louis and in the territory westward to the World's Fair grounds, with location, rates and other information.

THE LAIDLAW-DUNN-GORDON COMPANY, of New York, has issued bulletin L508, describing its improved "Cincinnati" air compressor. The distinguishing feature of this machine is the novel manner in which the opening and closing of the exhaust ports are controlled. The exhaust opens through poppet valves. The closing of the exhaust is determined by Corliss valves located in the passages between the cylinder and the poppet valves. These prevent all leakage of air back through the poppet valves while they are closing and also, by providing a cushion of air under full pressure, allow them to seat easily and without noise. The opening and the closing of the admission are determined by the Corliss valves entirely. These and other novel features of this compressor are fully explained in this pamphlet, which is well printed upon coated paper and handsomely illustrated. It will be sent upon application to any one interested in air compressing machinery.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has recently closed the following contracts for batteries of the chloride accumulator for lighting and power: The Union Electric Light and Power Company, St. Louis, Mo., a battery having a capacity of 462 kilowatt-hours in its exciter substation; the St. Louis Transit Company will have installed fifty-five cells of chloride accumulators in its new substation for the purpose of operating time switches; the World's Fair Automobile Transit Company has given an order for 100 sets of "exide" batteries, each set consisting of forty-four cells, to be used for the operation of the bus line which will be in service at the fair. Isolated lighting and power plants have been contracted for by the Union Trust Building Company, Detroit, Mich.; Morton F. Plant, Groton, Ct.; Abenaque Machine Works, Abenaque, Westminister County, N. Y.; Bank of Renovo, Renovo, Pa., and the Tucker Electrical Construction Company, for the residence of A. G. Huntington, at Bay Chester, N. Y. The Consolidated Railway Electric Light and Equipment Company has contracted for 1,020 240-ampere-hour batteries for car lighting; the Herreshoff Manufacturing Company will install on Mr. Herreshoff's private yacht a complete lighting and power battery for operating the searchlights, ventilating fans, and electric light throughout the boat; a smaller battery will also be used in connection with an electric launch to be used as a tender for this yacht. The yacht Marjorie and the yacht Roxana will each have a battery of chloride accumulators installed for lighting purposes.

OBITUARY NOTICE.

MR. JOHN B. O'HARA, associate editor of the *Street Railway Journal*, of New York, died in Rochester, N. Y., on Sunday, March 13. Mr. O'Hara was thirty-eight years of age, and was well known, both in the electrical and daily newspaper field.